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ABSTRACT

This manual is designed to help beginning vocational-technical education teachers, especially those who are subject-matter experts but who may not have been trained in education, to develop the teaching skills and knowledge they need to succeed. Each of the 12 chapters is a learning module that uses an individualized, self-paced delivery system. Each chapter contains objectives, practical application activities, and a self-test. The chapters cover the following topics: (1) characteristics of students; (2) you as teacher; (3) an overview of teaching; (4) course construction; (5) developing course outlines; (6) developing instructor lesson plans; (7) developing student lesson plans; (8) the computer as a teacher's aid; (9) methods of instruction; (10) assessment and testing; (11) other methods of assessment; and (12) scoring and grading. Appendixes include a sample course outline, sample lesson plans, answer keys to the self-tests, and a list of 31 resources. (KC)

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Learning How To Teach

A Quick-Start Guide for Vocational-Technical Education Teachers

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Learning How to Teach

A Quick-Start Guide for Vocational-Technical Education Teachers

Niel A. Edmunds and Clifton L. Smith

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INTRODUCTION

Teaching is a challenging business. This manual is prepared to help you face the challenge of your first years in the classroom. We especially hope to help beginning teachers who have a solid background in an occupational specialty area, but who may have limited or no exposure to vocational-technical education teaching.

Unfortunately, technical expertise in a subject area does not guarantee instant ability to teach that subject. Even the most thorough preparation in a field provides no assurance that a person's skills and knowledge can be effectively passed on to students. Teaching requires skills that are different from doing. To be successful, a teacher must understand how to plan and construct a course, how to develop lesson plans and how to use the various techniques, processes and materials of the teaching process to reach out to different types of students.

That's where this manual comes in. We have designed its units to help you develop the teaching skills and knowledge you need to succeed. The qualities and abilities described here have been identified by researchers as essential for teaching.

Each chapter in this book is a learning module that uses an individualized, self-paced delivery system. Each chapter contains objectives for what you will learn, practical application activities for reinforcing learning and a self-test that allows you to measure your learning. Answer keys to all self-tests are in the appendices so you can check your work before going on to the next chapter.

Ideally, the best way for us to help you learn to teach would be to sit down and talk with you and other new teachers. However, since that isn't practical, and since your schedule — particularly if you are a part-time teacher still working in industry — may not allow you to take a traditional class, these modules offer an individualized, self-paced way for you to learn about teaching. We encourage you to discuss what you are learning with your colleagues, ask for their input in completing activities and learn all you can from professionals in the field.

We hope this manual will inspire you to seek and develop more advanced teaching skills as you become more comfortable with your role as a vocational-technical education teacher. Teaching is one of the most rewarding jobs in the world. We hope you find the process of learning how to teach rewarding as well.

CHAPTER 1

Characteristics of Students

OBJECTIVES

After completing this chapter, you will be able to:

- List the general characteristics that may affect each student's ability to learn.
- Recognize the diversity of learners in today's vocational-technical education classes.

Vocational-technical education students in today's schools are drastically different than they used to be. At the same time, they are pretty much the same as they have always been — unique. Vocational-technical education students vary greatly with respect to age, prior experience, learning styles, interests, maturity, attention span, socioeconomic background, aptitude and attitude. No two students in your classes are likely to be at the same point of readiness and ability to learn. Nor are they likely to proceed through the course and related activities at the same rate.

Once you understand individual differences in your students, you can modify your teaching techniques, strategies and materials to make them work for all students — so all can gain the skills they need for good jobs or further education.

Identifying Student Differences

Dealing with the diversity of your students is one of the biggest challenges you will face as a vocational-technical education teacher. The greater the differences among your students — particularly between the most advanced and the slowest students — the more you need to understand the possible causes of these differences, and the more you need to adjust your teaching process to reach all students. Your goal should be to enable each student in your class to achieve the highest success possible.

A first step to working with a diverse student body is to understand the basic differences in students and how these differences can affect their response to the educational environment. Let's discuss the main differences you might encounter.

Age

Students in vocational-technical education programs may differ widely in age. Those in high school programs tend to be about 14 to 19 years old. Those in postsecondary schools include young adults through senior citizens. A student's age and maturity affect his or her self-concept, degree of life experience, willingness to take risks, reasons for attending school and expectations of school and a vocational-technical education program.

Learning Styles

Educators have theorized that there are three main styles of learning — cognitive, affective and manipulative.

- Cognitive learning refers to the accumulation and use of facts and knowledge — in other words, "thinking skills." For example, a drafting student who applies the Pythagorean theory to solve a question regarding a right triangle is using cognitive learning.
- Affective learning concerns issues that are more subjective, emotional and value laden, such as whether a student observes and follows safety rules closely or cuts corners.
- Manipulative learning entails the development of physical skills that require the coordination of mind and body, such as the ability to solder wires, cut dado joints, adjust a machine, etc.

These categories can be further broken down into learning style differences typically encountered in the vocational-technical education classroom:

- Some students prefer to learn alone while others prefer group activities.
- Some students are more competitive than others.
- Some students learn better by hearing things, while others learn better by seeing things or doing physical activities.
- Some students solve problems and answer queries by impulse while others are more reflective.
- Some students like to deal in generalities while others focus on detail.

Vocational-technical education teachers have long been aware of these distinctions about how students learn. Yet most vocational-technical education teachers still continue to teach with only one or two familiar styles, aiming their teaching at the "middle of the road" type of student and hoping they somehow reach everyone in the process. As will be discussed later in this chapter and in Chapter 9, it is important to vary your teaching style and the kinds of activities and assignments you use in the class to reach all different kinds of learners.

Prior Experience

A person's background provides the basis for acquiring additional knowledge and skills. In general, the more extensive and varied experiences a student has, the easier it is to acquire new knowledge and skills. Some of your students will have experienced success in prior education and training and will come to your class with confidence and a positive approach toward learning. Others may have had trouble in previous classes or programs, and may feel insecure, wary and defensive when it comes to formal education. You should take your students' varying levels of experience into account in planning your lessons and interacting with students in the classroom.

Interests

Your students' interest in the material you are teaching will vary widely. Responding to these differences will be one of your challenges as a teacher.

People tend to learn well and readily things that vitally interest them. However, mental processes may rebel and cease to function when people fail to see how what is being taught relates to their lives. Teaching can be quite frustrating when the student has little or no motivation. Part of your job as a teacher is to help each student see how the material you are teaching relates to his or her life. By doing this, you will motivate the student to meet you halfway in the learning process.

Attention Span

Some of your students will be able to focus on an activity or discussion for a long block of time; others, for whatever reason, will have very short attention spans. The latter kind of student will have a hard time focusing attention on the lesson to be learned or the skill to be developed. Varying your teaching techniques and using active, hands-on learning or collaborative

learning instead of passive methods may help these students. You may also be able to help them develop better attention and concentration skills that they can apply elsewhere.

Socioeconomic Background

There have been many changes in the demographics of students in today's schools, particularly in vocational-technical education settings. More students are poor; more students belong to an ethnic minority and may lack proficiency in English; more students come from single-parent or divorced families or have children of their own; more students have learning disabilities or drug- and alcohol-related problems. As a teacher, you will need to recognize and be sensitive to these realities.

Children from minority groups make up a large portion of the school population, and their numbers are expected to increase. Although many children from minority groups do well in school, many others have problems adapting to school programs. Sometimes language is a barrier. Research also indicates that racial and ethnic minority families are disproportionately poor, and for many reasons poor students often don't do well in school. Too many young people from poor families are assigned to special education classes because of cognitive or developmental problems, or even because of misunderstandings and prejudice.

Many disadvantaged students take vocational-technical education classes because they do not plan on attending college. And rigid tracking systems often place students who don't do well academically in the vocational "track" rather than in college preparatory courses. By the time they reach vocational-technical education classes, many of these students are so turned off to school and so unsure of their abilities that they are hard to reach and teach, and many drop out.

As a teacher, you cannot solve your students' family, economic or substance-abuse problems, and it is not your responsibility to do so. But you will run a better class and stand a better chance of reaching all students if you are sensitive to problems like these that get in the way of learning. There are strategies you can use with students from disadvantaged families who are having trouble, including the following:

- Refer students to the school counselor or community resources (such as programs for Hispanic teens).
- Help students find tutors for language, math or other special problems.

- Find creative teaching strategies that reach these students best (see Chapter 9).
- Present role models or connect students to mentors.

Many teacher education programs offer courses in teaching students with special problems. You may want to take such courses through a program near you.

Aptitudes

Aptitude is defined as the potential within each student that, with learning and practice, should lead to the student's future success. Aptitude can often — although not always — be identified by observing how well a student performs or by standardized aptitude tests. Ideally, you should be able to recognize each student's aptitude in various areas and facilitate development in those areas offering the highest potential.

At some point you will have students in your class who are labeled "exceptional learners." This term is generally applied to students at both ends of the spectrum: those who have physical or learning disabilities, or those who are considered academically gifted. Don't let the label be all you see of the student. Remember that there are individual differences, strengths and weaknesses among students labeled "exceptional" as much as there are among any other students. Some are visual learners, some are hands-on learners, some feel good about being in school, and some would rather be elsewhere. It is important to keep these individual differences in mind as you prepare the objectives, learning activities and overall outcomes of each class.

Attitudes

Attitude is the tendency to respond favorably or unfavorably toward a person, object or situation. Attitudes can enhance or impede the instructional process. Individuals tend to base their attitudes on what they perceive are facts, even if other people perceive the facts to be something different. Like most people, students tend to develop positive attitudes about things that seem to help them toward a goal and negative attitudes about anything that gets in their way. You will need to get a feel for your students' attitudes about what you teach, and try to foster positive attitudes in the classroom.

Making Learning Meaningful

Because of the differences outlined above, your students will learn and apply information in different ways. To respond to different ways of learning, you must first get to know your students as quickly and completely as possible. Over the years, as you gain experience teaching students in the class and laboratory, you will develop the ability to almost intuitively identify your students' differences and what teaching methods to use to address these differences.

We also recommend that you develop a Student Profile Form, such as the one shown in ***Exhibit 1-1.*** At the beginning of each semester, have each student complete the form by recording his or her age, interests in and out of school, employment and family situation, career background, etc. You can also add notes and observations based on your own interactions with the students. Having this information, you can manipulate both the type and amounts of information and skills activities necessary to accommodate these differences. For example, if you are a welding teacher, it would be important for you to know that some of your students were raised on farms and have been exposed to basic welding procedures through working on farm buildings and equipment, whereas other students might never have seen welding close up.

As mentioned previously, using a variety of teaching styles in your classroom will help you reach students of all learning styles. Here are some strategies you can use:

- Present information both orally and visually and through hands-on activities.
- Use both competitive and noncompetitive activities.
- Use collaborative learning to allow the more able and motivated students to help guide other students who are having difficulties.

You should divide the content you are teaching into segments and time frames that are compatible with the ability level of most students in your class, and then teach those segments in a sequence moving from easiest to most difficult. Most important, place the content and skills you are teaching in a meaningful context for your students' lives.

EXHIBIT 1-1

Student Profile Form

LAST NAME	FIRST NAME	AGE	CLASS/GRADE

ADDRESS	HOME PHONE

PARENT(S)/GUARDIAN(S)	OCCUPATION(S)	DAYTIME PHONE

YOUR CURRENT EMPLOYER	❑ PART-TIME ❑ FULL-TIME
	HOURS PER WEEK

JOB DESCRIPTION

OTHER JOBS YOU HAVE HELD

VOCATIONAL COURSES YOU HAVE TAKEN OR ARE TAKING

HOBBIES OR ACTIVITIES OF INTEREST IN SCHOOL

HOBBIES OR ACTIVITIES OF INTEREST OUTSIDE SCHOOL

PRESENT AND FUTURE EDUCATION AND/OR EMPLOYMENT GOALS

Practical Application Activities

1. Interview two or more teachers, including at least one from outside vocational-technical education. Ask them how they think students differ in learning styles and what techniques or activities they use to cope with these differences.
2. Assemble a collection of professional journal articles focusing on practical things teachers can do to help students with different learning patterns and abilities to succeed in class.
3. Prepare a Student Profile Form you can use in the classroom to gather data on each student. To develop the form, list all the descriptive information you think is important to collect about your students, and ask other teachers for samples of similar forms they use for this purpose. Then have other teachers review and critique your form before using it.

Self-Test for Chapter 1

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. List some kinds of vocational-technical education students that fall under the general heading "exceptional learners."
2. Why is it important for the vocational-technical education teacher to be able to recognize learning-disabled students, advanced students and other unusual students as well as the "regular" students in the typical classroom?
3. Why is it important for the vocational-technical education teacher to understand the different learning styles that exist among students?
4. What kinds of information should teachers gather about their students for a Student Profile Form?

CHAPTER 2

You As Teacher

OBJECTIVES

After completing this chapter, you will be able to:

- List and describe characteristics recognized as being desirable in good vocational-technical education teachers.
- Identify attitudes and actions that motivate students to do their best in the vocational-technical education classroom.

Whether you have state-of-the-art equipment in your vocational-technical education school or outdated textbooks and leaking labs, the facilities and equipment are at best only the setting for learning. The decisive factor in the educational process — the element that determines the excellence or failure of instruction in your program — is you, the vocational-technical education teacher.

As a teacher, it is your responsibility to create an environment that helps students obtain meaningful learning experiences. Your primary task is to motivate your students to want to learn and to perform effectively in various situations. You are the key to everything that occurs in the classroom.

Qualities of a Good Teacher

Teaching is a complex set of activities. Teachers must face many situations, and must consistently act and react in a way that maintains a good atmosphere for learning. This consistency in challenging situations requires qualities that center on organization and working effectively with people.

It is somewhat daunting to review the long list of attributes that research has shown to be desirable in vocational-technical education teachers. These traits include: cooperation, kindness, patience, understanding, varied interests, excellent communication skills, pleasant appearance, pleasing manners, humor, positive attitude, consistency without rigidity, interest in students,

commitment to teaching, acceptable values system and outstanding occupational skills and knowledge.

What we know of human behavior tells us that no one person is likely to possess all of these traits nor be in a position to practice each of them on a daily basis. But if you have some of them — particularly a positive attitude and a commitment to students and teaching — you can be a good teacher.

Skill as a good vocational-technical education teacher takes time to develop. Over the years, you will get a sense of your own personal strengths and limitations, and you will adjust your teaching strategies accordingly. Your temperament, interests, individual philosophy and your physical, mental and emotional condition can affect and reflect your skill and success as a teacher. If you maintain self-awareness and flexibility, you will eventually become a seasoned, experienced and motivated performer in the classroom.

One of the most important qualities for a successful teacher is the ability to organize your environment. As a vocational-technical education teacher, you must organize lesson planning, paper grading, administrative chores and any extracurricular responsibilities you've been given. If you can organize your time to successfully balance all these duties, you will have fewer problems in the teaching arena.

Planning and organization in the following areas will help you meet the challenges of the job:

- Assemble and organize the syllabus, texts, teacher guides and student guides for each course to be taught.
- Before beginning your course, carefully analyze tests published for the textbooks you are using (often available from textbook publishers). If tests are not available, try to obtain other tests from publishers or fellow teachers. Reviewing how prepared tests treat and emphasize various aspects of the course content may help you decide what to emphasize in teaching. Prepared tests can also provide suggestions for preparing your own exams, but you will need to consider carefully whether prepared tests are appropriate. (See Chapters 10 and 11 for more information on preparing tests.)
- Make sure you have all the proper tools, equipment and materials needed to teach the course content you have selected. It is surprising how often teachers try to show students a new technique or help them master new equipment when they do not actually have the equipment in the class-

room or lab. If you do not have the tools to teach your chosen content, you will need to modify your course — or you can be proactive in obtaining needed resources by contacting your supervisors, school administrators or other sources, such as local business partners.

- Review laboratory setups to ensure that the activities you are planning can be accomplished within the constraints or limitations of the facilities — or take proactive measures to overcome those constraints or limitations.

Personality and Professionalism

There are also more personal attributes that a good vocational-technical education teacher should possess. While we can't go into great detail here concerning human development and psychological theories, we can mention some of the key qualities you should have as a teacher and a role model.

As a teacher, you set an example for students to follow in your professional appearance, speech, mannerisms and behavior in the classroom. It is important that you make rational judgments, take appropriate action and openly accept responsibility for any consequences of your actions. You can help your students see the importance of these qualities by pointing out situations in the workplace that will require them to exercise sound judgment and to take responsibility for their actions.

You should always reflect a positive attitude and a recognizable appreciation and respect for the teaching profession. It should be clear to everyone that you are committed to continuous self-improvement and educational advancement, and that you understand that teaching requires continuing growth. Your commitment to learning will help make your students more interested in learning, both in your classroom and as they enter the workforce. Consider living out your commitment to the profession and lifelong learning through the following activities:

- Attending classes, workshops, seminars and similar activities to strengthen your teaching skills.
- Participating in professional organizations and activities.
- Using professional journals and materials to update your skills and knowledge.
- Spending extra time with students.
- Discussing with colleagues practices related to teaching.

Accepting Yourself

The ability to accept yourself as you are and to recognize your own strengths and weaknesses should be one of your goals as a vocational-technical education teacher. While honest self-assessment can often help you become aware of these strengths and limitations, it's also important to seek the input of both peers and students through formal evaluation or informal discussion. If you make sure to accept feedback about your performance in a positive way, you should be able to build a strong self-concept and confidence in your abilities.

Many ingredients go into becoming a successful vocational-technical education teacher. The most important traits are to be committed to students and to be yourself. Your best qualities will combine to help you give students the experiences and knowledge they need. The best measure of your effectiveness as a teacher is that what occurs in your classes prepares students well for success in their vocational-technical field.

Practical Application Activities

1. Prepare a list of source materials related to characteristics of good teachers. To get you started, ask other teachers for ideas. From these, prepare a list of attributes you think are most needed for good teaching and then analyze yourself with respect to these desirable traits.
2. Being as objective as possible, make a list of what you see as your strengths and weaknesses as a teacher. Compare yourself to the list prepared in the first activity above. Identify the main areas in which you feel you need to improve, and consider strategies to become a stronger teacher in those areas.

Self-Test for Chapter 2

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. What steps do you need to take to get organized to teach?
2. What are some qualities associated with good teaching?
3. What criteria should ultimately be used to measure your effectiveness in the laboratory and/or classroom?

CHAPTER 3

An Overview of Teaching

OBJECTIVES

After completing this chapter, you will be able to:

- Define the term "teaching."
- List several important principles of learning.
- Explain each of the four traditional teaching steps.
- Write acceptable teaching/learning objectives.

One of the hard things about being a vocational-technical education teacher is that society's expectations of you keep changing. The complex role of the vocational-technical education teacher has been shaped over the years by historical and social forces. In the 1950s and early 1960s in this country, the primary concern was with the moral character of vocational-technical education teachers. Today, the public has greater concern about an individual instructor's teaching abilities, yet vocational-technical education teachers are also expected to be role models and to provide a certain amount of moral guidance.

Teaching actually entails a great deal, and it is critical that you have a sense of what teaching is before you develop your own philosophy and system of teaching.

What Is Teaching?

Many definitions of teaching exist, some simple and some complex. The best definitions relate teaching to learning. If the purpose of teaching is to facilitate learning, teaching can be defined very simply as "helping students learn." Although this definition is simple, the processes involved are not. You will need to study these processes, apply them and evaluate them — both initially and over time during your career as a teacher.

Learning to teach is a developmental process, and teachers typically go through predictable stages. The first stage is one of survival. Beginning teachers wonder and worry about their interpersonal inadequacies, whether the students accept them and whether they can control the classroom environment. The second stage of development centers on the teaching situation itself. Teachers develop an increasing awareness of the time commitment needed for effective teaching and the flexible teaching skills needed to serve the variety of students in their classes — and whether they as teachers have those skills. In the final stage, the teacher becomes aware of the personal, social and educational needs of each individual student.

How People Learn

Because the outcome of good teaching is learning, a first step in learning how to teach is to look at how people learn. Study the following principles of learning, which vocational-technical educators have long recognized.

1. People learn best when they are ready to learn. People who have a definite reason for learning or who see the usefulness of what is being taught are more apt to be receptive to learning. This means that teaching requires more than just presenting information. As a vocational-technical education teacher, you must help your students see the usefulness and relevance of what they are learning. When they do, they will be more apt to take an active role in the learning process.
2. People learn more easily when what they are learning builds on something they already know. When planning your instruction, relate the new to the old. Start with something that is familiar to the students and build up to the new information or skills.
3. People learn step by step. Instruction must be logically organized and must move from the concrete to the abstract or from the known to the unknown. Students learn best when they know where they have been, where they are now, where they are going and how they are going to get there.
4. People learn by doing. By itself, telling is not teaching. You can tell students how to do something before showing them how to do it, but until they have actually tried to do it themselves, no real learning has taken place. For example, you might tell a child how to ride a bike and then demonstrate how to ride the bike. But until the child actually tries to ride, falls down, tries again and finally conquers the challenge, the child has not learned.

5. The more often people use what they have learned, the better they understand it. Constant reinforcement through practical application activities is necessary for learning to take place.
6. Success in learning stimulates additional learning. You need to present new material to students in small enough doses so that they can understand and apply it successfully. With time, experience and growth, their doses can be increased. The key is to give them doses that are large enough to be challenging, but small enough to allow for success.
7. People need immediate feedback to know whether or not they have actually learned what they have been taught. It is important to evaluate students' learning frequently and to give students information about their performance promptly.

The Teaching Steps

One of the most successful teaching methodologies is far from innovative, new or gimmicky. In fact, it is quite old and traditional. Yet it has one redeeming quality — it works! This method uses four steps proven to help teachers teach better: preparation, presentation, application and evaluation.

Step 1: Preparation

In this step, you take care of all the advance preparation necessary to ensure successful teaching and learning of a lesson. This involves preparing yourself so that you know the content and how you are going to present it, preparing any handouts or other materials for the lesson, preparing the shop or classroom and preparing the students by alerting them to what they will be learning and giving them any background knowledge or skills they need to accomplish that learning.

Step 2: Presentation

In this step, you actually present the material you have prepared in the first step. A number of methods (discussed in detail in Chapter 9) can be used for presenting information. Remember, it is a good idea to vary your methods rather than sticking to just one.

Step 3: Application

In this step, you give students an opportunity to apply what they are learning. This is a critical step. In fact, many veteran teachers in vocational-technical education believe that this is

the most important step. No real learning takes place until students apply the various principles and skills they have been studying. For example, if a student is studying gas welding, the application step would require the student to actually perform several gas welding tasks. If a student is studying auto mechanics, application might involve performing a tune-up or brake job or any other type of hands-on task.

Step 4: Evaluation

This is the step in which the student and the teacher determine how much learning has taken place. There are a number of evaluation techniques such as written tests, skills tests, observation or some combination of these. (These techniques are discussed in detail in Chapters 10 and 11.) Regardless of the evaluation methodology used, it is important to provide feedback as quickly as possible — immediately, if possible.

Developing Instructional Objectives

Many vocational-technical education teachers now recognize that one of their weaknesses as instructors has been developing clear objectives. Our objectives — what we want the students to learn and master in the course — are seldom made clear to the students either at the beginning of the course or during it. Rarely do our objectives meet with the students' goals for taking the class. We just teach. But do the students learn?

Too often, vocational-technical education teachers spend hours preparing for class and identifying new equipment, tools or materials without really asking themselves, "What do I want the students to know or be able to do when they complete the course?" If this question remains unanswered, the teacher has no reasonable criteria for selecting methods of instruction and will never truly know what has been accomplished throughout the course. Nor will the students know whether they have fulfilled the course requirements or adequately developed the skills and knowledge necessary to be successful in the workforce.

Teaching is a process of promoting change in students. The change may be far-reaching, such as helping students develop a new conceptual framework. It may also be quite precise and simple. The extent and shape of these changes depend on what the instructor wants the student to know or be able to do. Instructional objectives indicate how students should change. They are road maps for the learning process, helping both

teacher and student know where they are going, how they will get there, and how they will know when they have arrived.

As stated earlier, some objectives are simple and easy to attain, but others are more complex. There are several approaches and a variety of formats for writing instructional objectives. However, any well-written instructional objective should say three things:

- What a student who has mastered the objective will be able to do (performance).
- Under what conditions he or she will be able to do it.
- To what standard he or she will be able to do it.

When writing instructional objectives, it is best to use precise words that are not open to many interpretations. Examples of precise words include *write, list, identify, describe* and *compare.* Examples of less precise words are *know, understand* and *appreciate.* ***Exhibit 3-1*** shows examples of effective instructional objectives, and ***Exhibit 3-2*** shows a checklist for evaluating the effectiveness of instructional objectives.

EXHIBIT 3-1

Sample Instructional Objectives

Cognitive Domain

These teaching activities build thinking or reasoning skills.

- Without the aid of reference materials, the student will identify by name eight of ten commonly used tools.
- Given a medical chart describing a patient's condition in medical terminology, the student will verbally describe the patient's condition. Acceptable performance is based on 90% accuracy.
- Given a structural steel problem, the student will completely plan the solution, including materials to be used and type of welds and procedures to be followed. Acceptable performance is based on using complete and logical operating procedures.
- On a unit test, the student will draw a logic diagram and a logic symbol, generate a truth table and complete a timing diagram for all latches discussed.
- Given appropriate numbers, the student will compute the quotient of two fractions with 100% accuracy.
- The student will distinguish among the terms *dandruff, conditioning, color* and *medicated rinses* by writing a definition of each, without error, in ten minutes.
- The student will define the terms *validity* and *reliability* and express the relationship between the two with 100% accuracy.

Affective Domain

These teaching activities focus on attitudes and feelings. It is difficult to write precise objectives for affective skills because emotions and attitudes are hard to observe objectively and to measure quantitatively.

- In a classroom situation, the student will take actions that show awareness of other students' feelings.
- In a laboratory situation, the student will take actions or say things to help other students develop safety consciousness.
- In relations with other people, the student will weigh the values of others before forming opinions.

continued

Exhibit 3-1 continued

- Each student will accept the values of organization and neatness as appropriate in solving mathematics problems by submitting completed homework assignments that are neat and well organized.
- Each student will develop and express in writing judgments regarding the positive and negative effects of mathematical and scientific progress on society. Acceptable performance will be measured by the quality of a written paper.

Psychomotor Domain

These teaching activities build hand and motor skills.

- Using a personal computer, the student will type a three-page manuscript with no more than five errors.
- Given ten soil samples, the student will use the field method to correctly identify the soil class for at least nine of the ten samples.
- Using a tachometer, the student will set the engine idle speed to within 50 RPM of the manufacturer's recommendations.
- Provided two 3" x 8" x 1/8" metal plates, the student will select an appropriate electrode, adjust the welding machine, and butt-weld the plates so they can withstand a 90° bend without breaking.
- Given the proper parts and component diagram, the student, within one hour, will construct an alternating current test lamp that will operate properly in an A.C. circuit.
- On level ground, the student will set up a transit within 30 minutes.
- Provided the necessary materials, the student will demonstrate the techniques used to turn a cylinder on the metal lathe to 1/2" diameter +/– .005".
- In small groups, students will measure the radial pulse of three classmates for one minute each, within three beats of accuracy.

EXHIBIT 3-2

Checklist for Evaluating Instructional Objectives

Consider using the following checklist to evaluate the effectiveness of instructional objectives.

1. Performance: Does the objective describe what learners will be doing to show that they have attained the objective?

   ❑ YES ❑ NO

2. Conditions: Does the objective specify the key conditions under which the learner must demonstrate competency?

   ❑ YES ❑ NO

3. Criteria: Does the objective describe the criteria by which the learner's performance can be judged?

   ❑ YES ❑ NO

4. Action Verbs: Is each objective stated in the most concise manner, using appropriate action verbs?

   ❑ YES ❑ NO

5. Prerequisite Order: For multiple-level objectives, are the parts of each objective listed in prerequisite order?

   ❑ YES ❑ NO

6. Learner Centered: Does the objective specify what the learner — not the instructor — is to do?

   ❑ YES ❑ NO

7. Analysis Base: Is each objective developed from an occupational analysis? [Editor's note: see Chapter 4 for a discussion of occupational analysis.]

   ❑ YES ❑ NO

Practical Application Activities

1. Make a list of the principles of learning, leaving plenty of space between each principle. Under each principle, list things that you do as an instructor to observe the principle. Then make a list of additional things you can do to ensure that each principle of learning is observed in the preparation, presentation, application and evaluation steps of your instruction.
2. Select a lesson from one of your courses. Make a list of things that you have traditionally done in preparing, presenting, applying and evaluating the lesson. Then make a new list of things you can do in the future in each of the four steps to improve your teaching.

Self-Test for Chapter 3

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. In as few words as possible, define the term *teaching.*
2. Why is it important to spend time helping your students understand why they are studying a particular lesson and how the information learned in that lesson might be applied later?
3. Why is it important to present instruction in an orderly, organized manner?
4. Why should you begin with something that is familiar to the students?
5. *Cognitive domain* generally refers to what kind of teaching activities?
6. Why is it difficult to accurately measure *affective domain* activities?
7. Why is it important to present instruction in small enough blocks to ensure that most students will be able to succeed?
8. List the four traditional teaching steps and provide a brief explanation of what the teacher does in each.

CHAPTER 4

Course Construction

OBJECTIVES

After completing this chapter, you will be able to:

- Define the following terms: *occupational analysis, curriculum, school curriculum, program curriculum, course,* and *course outline.*
- Describe the occupational analysis process and how it relates to course content identification.
- Explain the purpose, uses and application of a course outline.
- Explain the various steps in course construction.

A vocational-technical education teacher's development of a course is comparable to an engineer's development of a blueprint for constructing a building. A completed blueprint shows all aspects of the final building, but the engineer knows that the project is actually made up of many small units or sections. Each section must be planned and constructed in precise detail so that the building is completed correctly. Likewise, the vocational-technical education teacher has to recognize that a successful course is actually made up of many smaller lessons and instructions, and all of these must be integrated so that the students properly understand and can apply what they have been taught.

Keeping in mind your instructional objectives, you will need to examine the content for each of your courses to determine how well course content will help students master the knowledge and skills outlined in your objectives. You must carefully select experiences that will produce the desired result.

What To Teach and How

Two questions arise early in the teaching experience:

- What should be taught?
- How should it be presented to students?

Sometimes you will be expected to develop new courses of study or a totally new program, even if you are a new teacher. In other instances, the course outline for your classes will be predetermined and will simply be given to you at the start of the school year. Even so, you might want to modify the outline throughout the school term, based on your prior knowledge and on what you discover about your students.

An overall understanding of the basics of the course construction process will help you determine what to teach. More detailed information can be obtained by participating in the activities suggested at the end of this chapter.

Occupational Analysis

You are probably familiar with the term *occupational analysis*, but you may not realize how such analysis fits in with vocational-technical education teaching. Occupational analysis is a process performed by industry to identify in detail the knowledge and skills needed for a particular job. Industry then presents this information to the educational community, and they work together to develop a curriculum that will teach students the skills they will use regularly in the workforce and that will clearly be relevant to their future livelihood.

Many seasoned vocational-technical education teachers and administrators believe occupational analysis is key to effective vocational-technical education. They argue that vocational-technical education curriculum is meaningless unless worker traits, attitudes and skills are made an integral part of the overall curriculum. Industry also highly values occupational analysis as the basis for determining how workers can perform better and be used better.

The occupational analysis process starts with a basic job description and breaks it down into successively more detailed descriptions of what a worker does on the job. With this information, educators can develop precise instructional objectives and learning activities to teach students the most essential knowledge and tasks required for the occupational area.

The individual vocational-technical education teacher rarely is involved in working with industry to perform an occupational analysis and develop a curriculum. This work is usually performed and made available by curriculum consortia in various regions of the country. Typically, a school district or state buys a curriculum from its local consortium and encourages all its vocational-technical education teachers to use it. But a basic under-

standing of occupational analysis and how tasks from such an analysis are chosen for a curriculum will help you use your curriculum confidently and effectively — and perhaps even to modify the curriculum to better reflect job tasks in your area.

Not every task identified by occupational analysis is appropriate for a vocational-technical education curriculum; curriculum developers must decide which tasks and skills to include. Experienced vocational-technical educators often use the following criteria to determine which tasks identified by an occupational analysis should be included in a vocational-technical education program. A task selected for instruction should meet at least one of these criteria.

- ***Task is performed by a large percentage of jobholders.*** If the task is performed by a large number of jobholders, it should be taught in the education program, unless the task is teachable on the job.
- ***Task is performed frequently.*** Some routine, simple tasks are performed so frequently that they are easily learned on the job. Normally, additional criteria should be used to support selection on the basis of frequency.
- ***Task is critical to job accomplishment.*** The more critical the task is to job accomplishment, the more important it is to include it in the training program. In addition to job analysis, the judgment of experienced jobholders and supervisors, obtained through interviews and questionnaires, can be used to determine how critical a task is.
- ***Task must be mastered before performing another task.*** Although certain tasks may not be ideal for educational settings, proficiency in their performance may be a prerequisite to performing other tasks for which instruction is necessary. For example, the task of disassembling and assembling an item of equipment may seem appropriate for on-the-job training, whereas the tasks of identifying, removing and replacing defective parts in that item are better taught in school. In this situation, since it is necessary to disassemble the item before defective components can be removed and replaced, the task of disassembly and assembly must be selected for the training program.
- ***Task must be performed immediately.*** If the task must be performed immediately at the beginning of the job — and other selection criteria also apply — that task should be taught in vocational-technical education programs.

Once curriculum developers and you as a teacher decide what skills to include in training for a vocational-technical field, you are ready to begin the process of course construction.

What Is a Course?

Developing instruction for vocational-technical education happens on four levels: the curriculum level, the program level, the course level and the unit level. A curriculum is the sum total of the learning experiences for which the school has responsibility. The curriculum may be subdivided into instructional programs, which in turn are usually divided into courses and finally into units of instruction. The instructional unit is the lowest level of instruction that has purpose, interest, unity and meaning within itself. ***Exhibit 4-1*** shows a basic curriculum flowchart.

Before you can understand what a course is, you must first understand the term *curriculum*. Curriculum is a broad concept, of which a course is an essential building block. Curriculum is defined as all of the planned experiences provided for students under the direction of the school. This includes activities designed to help students mature in terms of attitudes, social skills and personality as well as traditional courses. A school-sponsored service club that seeks to develop students' leadership skills is just as much a part of the curriculum as a class in basic auto mechanics.

Each school (or school system) has a curriculum, known as the *school curriculum*, which consists of all planned experiences the school provides for students through its education programs. In turn, each individual program within a school has a curriculum known as the *program curriculum* (for instance, the drafting program curriculum or the welding program curriculum). Vocational-technical education program curriculums are made up of courses. ***Exhibit 4-2*** presents an example of a program curriculum for a one-year residential construction program. Each individual entry would be a course in the program.

A *course* can be defined as the plan for one well-defined part of a program curriculum that is designed to help students meet a set of learning goals. Courses may be scheduled so that students complete them within a certain prescribed time, such as one semester or one six-week period, or they may be presented in a competency-based, self-paced format. In either case, courses are the primary building blocks of vocational-technical education program curriculums.

EXHIBIT 4-1

Basic Curriculum Flowchart

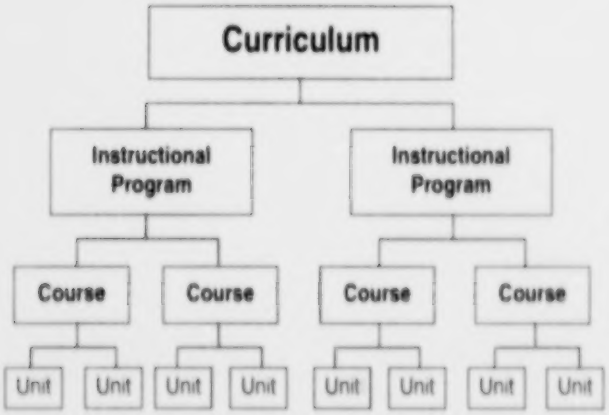

EXHIBIT 4-2

Curriculum for Residential Construction Program

- Building Construction Blueprint Reading
- Residential Construction Estimating
- Reinforced Concrete, Steel and Masonry
- Electrical Systems
- Plumbing Theory
- Design, Estimating, Blueprint Reading and Drafting
- Woodworking
- Tools and Materials

Course Construction and Course Outlines

A course outline is your master plan — the "blueprint" — for teaching a course. Every course should have a comprehensive course outline containing the following:

- A statement of purpose that explains the overall objectives of the course and where the course fits into the program curriculum.
- A list of broad instructional goals for the course explaining exactly what students will learn.
- A list of the units that make up the course.
- An explanation of the method(s) you will use to instruct students in the course.
- An explanation of how you plan to evaluate students.
- An explanation of how you will compute students' grades.
- A list of resources needed for the course, such as required textbooks, expendable supplies, teaching aids and tools.

In constructing your course, you will basically be making decisions about each element in your course outline — deciding on the purpose for your course, your instructional goals, how you will divide material into units and so on. Each element, then, represents a key step in course construction. It's important to go through the steps in the order laid out here. (The next chapter will take you through a step-by-step procedure for constructing your course and creating your course outline.)

A good course outline will provide you with a comprehensive set of guidelines for doing the more detailed week-to-week and day-to-day planning for a course. If you are teaching a course for the first time, you would use the course outline as a guide in developing individual lesson plans. Some teachers develop course outlines in such a way that each instructional goal in the outline becomes the major goal of one individual lesson plan, which is then translated into more specific learning objectives.

Practical Application Activities

1. Obtain a course outline from an instructor on the faculty where you teach. Examine it closely and ask yourself these questions about the outline:
   - Does it have a statement of purpose? If so, what information does the statement contain?
   - Does it contain a list of instructional goals? If so, are they stated in a form that explains what will be learned?
   - What types of instructional methods are recommended in the course?
   - What is the grading scale used for converting numerical scores into letter grades?
   - What is the title of the textbook used in the course?
2. Make a list of pertinent questions that are not addressed in the course outline but that you would ask if you were called on to teach this course.

Self-Test for Chapter 4

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. Define the following terms:
   a. Curriculum
   b. School curriculum
   c. Program curriculum
   d. Course
   e. Course outline
2. What are the components of a course outline?
3. What should be explained in your course's instructional goals?

CHAPTER 5

Developing Course Outlines

OBJECTIVES

After completing this chapter, you will be able to:

- Write a statement of purpose for a course.
- Write a set of instructional goals.
- Write a statement of instructional methods.
- Write a statement of evaluation methodology.
- Write a statement explaining your grading system.
- Develop a resource list for a course.
- Combine the above items into a comprehensive course outline.

As shown in Chapter 4, a course outline is the blueprint you need for preparing and presenting a course as a vocational-technical education teacher. This chapter will take you through the step-by-step process of constructing a course outline. The key elements in a course outline are listed in ***Exhibit 5-1.*** A sample course outline for a computer-aided drafting course appears in Appendix A.

Scope and Sequence Outline

Before you begin creating your course outline, you need to develop a general outline of topics to be covered in the course. This is sometimes referred to as a "scope and sequence" outline. There are a number of ways to develop such an outline. One way is to obtain several textbooks that are commonly used to teach the subject and review the main topics covered in these texts. You might look at the course outlines of teachers who have taught this subject in the past. You might also gather some experts on the course subject matter from industry and education to examine the rough draft of your scope and sequence outline and determine what should be added and what should be

EXHIBIT 5-1

Key Elements of a Course Outline ("Scope and Sequence Outline")

- Statement of Purpose
- Instructional Goals for the Course
- Instructional Units of the Course
- Statement of Instructional Method(s) for the Course
- Statement of Evaluation Methodology for the Course
- Explanation of Grading System
- List of Required Resources

deleted. The resulting outline is used as a tool in developing the actual course outline.

Statement of Purpose

The statement of purpose is a brief statement explaining the overall purpose of the course and where the course fits into the program curriculum. Following is a sample statement of purpose for a machining course:

> Machining 1 is the first in a series of ten courses that make up the machining program curriculum. The purpose of this course is to help students develop all of the fundamental knowledge, skills and attitudes needed to be successful in studying the advanced courses that follow. Student learning will include safe shop practices, working in teams, basic machining operations, blueprint reading and machining math.

Instructional Goals

The instructional goals for your course explain what students will learn in the course. They are developed from the topics listed in the scope and sequence outline prepared as a preliminary step to working on the course outline. Instructional goals should be stated in terms that explain precisely what students will learn, not what subject matter will be covered.

Exhibit 5-2 shows a preliminary scope and sequence outline for a basic drafting course and a partial set of instructional goals developed from that outline.

EXHIBIT 5-2

Preliminary Scope and Sequence Outline

Topics	*Instructional Goals*
1. Lettering, line work and scale use 2. Dimensioning practices 3. Orthographic projection 4. Sectioning 5. Auxiliary views 6. Isometric drawing 7. Oblique drawing 8. Perspective drawing	After completing this course, students will be able to: • Demonstrate proficiency in all types of freehand lettering, including upper-case, lower-case, vertical, inclined block and architectural. • Demonstrate proficiency in constructing the various types of lines used in drafting, including object, hidden, dimension, extension, leader, sectioning, cutting plane and phantom lines. • Demonstrate proficiency in the use of the architect's, engineer's and metric scales. • Demonstrate proficiency in developing orthographic projections and converting them into finished multi-view drawings. • Demonstrate proficiency in cutting sections and then drawing removed, revolved and broken out sections.

Instructional Units

Typically, once you have determined the courses necessary to support the curriculum, you must further break them down into units of instruction. These units make it easier to structure and sequence the delivery and learning processes. Quite often, the units are determined and arranged by quarter, semester or even yearly time frames. Once you have selected and arranged the

units in the instructional order, you must develop and expand them so that you can provide clear, proper instruction.

Statement of Instructional Methods

There are many methods of instruction you can use in your vocational-technical education courses. Lecture/discussion, demonstration, computer-assisted instruction and cooperative learning are some of the more frequently used and most effective methods. This statement simply explains the method of instruction you recommend using in the course. (Chapter 9 discusses these methods, also called "instructional delivery systems.")

The following is an example of a statement of instructional methods for a basic electronics course:

> A combination of the lecture/discussion and demonstration teaching methods, followed by applied skills activities, is recommended for this course. Students should prepare for lecture/discussions by reading or viewing appropriate material and/or conducting research into the topic in question. The instructor then presents a lecture covering all theories, principles and concepts relating to the topic in question. This is followed by demonstrations of the various skills that will be developed. Students are then given practical application activities such as experiments and trouble-shooting projects. Students will be evaluated on these projects. Also, once all activities and projects have been completed, students are evaluated on what they have learned. Students must demonstrate proficiency in all tasks before proceeding to subsequent courses.

Statement of Evaluation Methodology

There are many ways to measure learning and progress in vocational-technical education courses, including objective written tests, skills tests and skills projects. This statement in your course outline should explain the method(s) you recommend for evaluating students in the course and approximately when or how often the methods will be used. The following is an example of an evaluation statement for a basic drafting course:

> Written objective tests, graded skills projects and skills tests are the recommended methods for conducting evaluations in this course. The teacher should test students' knowledge of principles, theories and terminology at least once each week using objective written instruments. Assigned skills projects or drawings should be graded in each class period. Skills tests that require students to apply theories, principles, terminology and skills should be administered at mid-term and at the conclusion of the term.

Explaining the Grading System

Your grading system statement explains how student evaluations will be scored and how scores are converted to letter grades. This statement should contain the following information:

- An explanation of how written tests are scored.
- An explanation of how skills projects and skills tests are scored.
- An explanation of how numerical scores (percentages) are converted to letter grades.
- A percentage breakdown for computing the final grade.

Exhibit 5-3 shows an example of a grading system statement that might be used for a drafting class.

Listing of Required Resources

Your course outline must contain a list of all materials the teacher and students will need to complete the course. These materials include required textbooks, reference books, expendable supplies, tools and teaching aids. ***Exhibit 5-4*** is an example of a resource list for a basic drafting course.

EXHIBIT 5-3

Sample Grading System for a Drafting Class

Written tests are scored as a percentage of correct responses. The percentage is computed by forming a ratio of the number of correct responses to the total number of possible correct responses. For example, a student who responds correctly to 56 out of a possible 75 correct answers would get a grade of 56/75, or .746, rounded off to 75%.

Skills projects and skills tests are scored using specific criteria accompanied by rating scales. Scores are expressed as percentages and are arrived at by forming a ratio of actual performance to expected performance. For example:

Criteria	**Scale**
Constructs proper solution	1 2 3 **4** 5
Correctly dimensioned	1 2 **3** 4 5
Correctly annotated	1 2 **3** 4 5
Accuracy	1 2 3 **4** 5
Neatness	1 2 3 **4** 5

In this example, the student scored 18 points out of a possible 25 for a score of 18/25, or 72%.

The following scale will be used for converting numerical scores (percentages) to letter grades: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

Final grades are computed according to the following percentages:

Average of all test scores	25%
Average of all skills projects	25%
Average of all proficiency exams	30%
Instructor's subjective judgment of attitude, work habits, attendance and attention to safety	20%
TOTAL	100%

EXHIBIT 5-4

Sample Resource List for a Drafting Class

Required Textbook

- *Exploring Drafting*, by John R. Walker, Goodheart-Wilcox Publishers, 1996

Recommended References

- American National Standards Institute (ANSI) Y14.5
- "Drafting as a Career," a brochure by the American Institute for Design and Drafting (AIDD)

Tools/Supplies

- Standard set of drafting tools
- 100% rag drafting vellum (30 sheets per student)
- 3 mil polyester film (15 sheets per student)
- Ammonia developing print paper (45 sheets per student)

Teaching Aids

- Overhead projector
- 16mm film projector
- 35mm slide projector
- Portable flip chart
- Markers

Practical Application Activities

1. Select a course in your occupational area and prepare a complete course outline for it.
2. Distribute copies of your finished product to several instructors and ask for their feedback. Review their comments and revise your outline in keeping with valid suggestions.

Self-Test for Chapter 5

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. What two items of information should be included in the statement of purpose for a course?
2. Identify several topics to be covered in your occupational area and state them as course goals.
3. What is a method of instruction (also called an "instructional delivery system")?
4. What is an evaluation methodology?
5. What four items of information should be included in a grading system statement?

CHAPTER 6

Developing Instructor Lesson Plans

OBJECTIVES

After completing this chapter, you will be able to:

- Define the term *lesson plan*.
- Explain why lesson plans are necessary for successful teaching and learning.
- Explain the differences between instructor and student lesson plans.
- List the various components of a typical lesson plan.
- Explain and perform the steps in creating an instructor lesson plan.

When we call up an image of a teacher, most of us see a woman or man in front of a group of students teaching a lesson. At the heart of all the activity surrounding teaching is actually leading students through well-planned lessons — and the key word is *well-planned*.

The lesson plan is the final link in the instructional planning process. A lesson is essentially a set of content and skills that are recognized as fitting together in a logical way. The lesson plan is a treatment, in detail, of a portion of subject matter to be presented to the students. It can be seen as a "road map" for a lesson that gives the teacher all the information and direction necessary to guide students through learning key material.

Good, thorough lesson plans will give you confidence while teaching in the classroom, especially during your first years. Effective lesson plans also:

- Clarify the things students are expected to know and do.
- Help motivate students to learn.
- Serve as a checklist to ensure that you've given students all the essential information they need.

- Help you identify instructional aids to enhance a lesson.
- Help you formulate questions to assess how well students are learning the material.

This chapter will examine the concept of lesson planning and guide you through the steps of developing a lesson plan from the instructor's perspective. (The next chapter will examine how to create a lesson plan from the student's perspective.)

What Is a Lesson Plan?

To a teacher, a lesson plan is like a road map. It shows in detail where you are going and how you will get there. Teachers who teach without first planning their lessons are like travelers who venture out without a map, get lost and then drive around in circles trying to find their way.

As discussed previously, a school's curriculum for vocational-technical education is divided into various programs. Programs are further divided into courses, courses are divided into units, and units are usually divided into several lessons. Thus the lesson is the basic building block of teaching. But before lessons can be taught, they must be planned.

In presenting courses, you need to make sure that your material is well organized, consistent, built on past learning and sequenced from the simple to the complex. Lesson plans are tools for meeting these goals. In planning a lesson, there are several key decisions you need to make, including the following:

- Where the lesson fits into the overall course.
- What the instructional objectives of the lesson will be.
- How the lesson will be presented and what tools, supplies and instructional aids will be required.
- What assignments will accompany the lesson.
- How student learning will be evaluated.

The lesson plan itself brings all this information together in an organized, annotated outline.

You can prepare lesson plans from either the instructor's point of view or the student's point of view. Some teachers prefer one method, some the other, and some use both. The primary difference is that an instructor lesson plan is written in terms that guide the actions of the instructor whereas a student lesson plan is written in terms that guide the actions of the student.

Do not be surprised if, in talking to your colleagues, you find that many experienced teachers do not use lesson plans. People who have taught a lesson many times may no longer have to depend on lesson plans, just as people who travel the same route every day don't need a road map to get to their destination. For the beginning instructor, however, lesson plans are essential. Even experienced teachers should have formal lesson plans on file so they can review their plans and occasionally update them.

Creating a Lesson Plan

Lesson plans come in many sizes and formats. Differences in length or style do not make one plan better than another. A good lesson plan can be a comprehensive, formally worded outline neatly typed on quality paper and enclosed in a plastic binder, or it can be a brief, handwritten outline on 3" x 5" cards. The styles of good lesson plans vary as much as their length.

There are many effective formats for lesson plans, and you can choose the one that best suits your needs. Many vocational-technical educators use the format shown in ***Exhibit 6-1,*** and it serves as a good starting point for beginning teachers. A sample lesson plan using this format is shown in Appendix B.

Each element in this format corresponds to a step in the systematic process of lesson planning.

EXHIBIT 6-1

Suggested Format for Lesson Plans

Write out your lesson plan as an outline containing and describing the following elements:

- Lesson number and title
- Statement of purpose
- Objectives of the lesson
- How you plan to present the information
- Materials required for the lesson
- What activities you will assign to reinforce learning
- How you plan to evaluate and grade the students

Steps to Developing an Instructor Lesson Plan

There are eight steps to developing an instructor lesson plan. Following these steps, which are listed below and described in detail immediately afterward, will help you create effective instructor lesson plans — especially if you are a new teacher.

1. Determine units and lessons.
2. Set sequence.
3. Write a statement of purpose.
4. Develop objectives.
5. Choose presentation method.
6. Select support materials.
7. Determine student assignments.
8. Set evaluation procedures.

Step 1: Determine Units and Lessons

Before actually creating lesson plans, divide all the material you plan to teach in your course into units and lessons. A unit represents a group of related knowledge and skills; lessons are smaller groupings of material within a unit. A lesson usually contains as much material as students can master within one class period, whereas a unit contains as much material that students can learn within several class periods or several weeks. For example, a lesson on lettering in a drafting course might be part of an overall unit on plate layout.

If you have trouble deciding how to break your overall material into units and lessons, study how other teachers teaching similar courses have done so in the past and ask your colleagues for help and advice.

Step 2: Set Sequence

Order your units and lessons in a logical sequence beginning with the easiest material and proceeding to the more complex or difficult. Again, consult other teachers if you need help deciding the proper sequence for certain units and lessons. Give each lesson a number and a name that corresponds to its material. From this point on, each lesson is planned individually.

Step 3: Write a Statement of Purpose

The statement of purpose for a lesson explains how that particular lesson fits into the overall sequence of lessons that make up your course, the main purpose of the lesson and the major topics covered in the lesson. A well-written statement of purpose is succinct and requires no more than a paragraph.

The following is an effective statement of purpose for a lesson on lettering in a drafting course:

> This lesson is the second of 15 lessons that make up the course. The purpose of this lesson is to help students become proficient in the use of freehand lettering. Topics covered include a definition of freehand lettering, how it is used, and why it is important; selecting the proper leads; using the lettering guide; and forming/spacing of letters.

Step 4: Develop Objectives

As discussed in Chapter 3, an instructional objective is a statement summarizing what students are expected to learn about each topic listed in the statement of purpose. Each topic can be converted into one or more objectives. Instructional objectives may be written in general terms or in very specific behavioral terms. In instructor lesson plans, objectives are usually stated in general terms, whereas student lesson plans usually use behavioral objectives.

Exhibit 6-2 shows sample instructional objectives, written in general terms, developed from two of the topics listed in the sample statement of purpose for the lettering lesson. Notice how the objectives relate to the topic.

Step 5: Choose Presentation Method

Choose the method of presenting the lesson — which is sometimes called the "instructional delivery system" — based on the best way to accomplish the lesson's objectives. In any given lesson, you might choose lecture/discussion, demonstration, question/answer session or any other accepted teaching method.

Often, combining various teaching methods within a lesson works best and reaches the most students. For example, for the objectives listed above, the instructor might use the lecture/discussion method for presenting the theory, concepts and background knowledge about selecting the proper leads for freehand lettering. However, for actually showing students how to letter, the instructor would use the demonstration method.

EXHIBIT 6-2

Sample Instructional Objectives

TOPIC	***A definition of freehand lettering, how it is used, and why it is important***	***Selecting the proper leads***
OBJECTIVES	1. Students learn the definition of freehand lettering. 2. Students learn ten ways in which freehand lettering is used. 3. Students learn to explain the importance of freehand lettering.	1. Students learn the various grades of lead used in drafting. 2. Students learn to classify leads as soft, medium and hard. 3. Students learn to select the proper lead for making guidelines, letters, numbers, notes and titles.

It is especially important for you as a vocational-technical education teacher to use the demonstration method as often as possible — especially with student interaction that provides them "hands-on" experience. The skills that vocational-technical education students are learning require them to ***do,*** not just see and understand. The lecture/discussion method will be necessary at times, especially at the beginning of an instructional unit, but vocational-technical education teachers must guard against using this method too much just because it might be easy to talk about a topic rather than plan a project that involves student interaction.

Many teachers find it helpful to write out the specific actions they will take in presenting the material. For the sample lesson on lettering, you might list these actions:

- Distribute the handout "Engineering Lettering."
- Present a lecture/discussion on lettering.
- Demonstrate the different types of lettering.

You might further write down notes on what you plan to say and what questions you will ask students in the lecture/discussion part of the lesson.

Step 6: Select Support Materials

Decide and list what support materials will be required for teaching the lesson. Most lessons in vocational-technical education classes require some kind of tools or supplies — such as drawing supplies or an overhead projector. Once all necessary materials are listed on the lesson plan, you can easily take inventory of what you have and what you need to acquire or repair before beginning a lesson. You should never have to stop a lesson in progress because an overhead projector or some industrial equipment does not work, or because you have run out of mechanical pencils.

The following is a list of materials required for the sample lesson on lettering:

- Handout titled "Engineering Lettering"
- Drafting paper and tape
- Two mechanical pencils
- Sample leads: 3H, 2H, H, F and HB
- Lettering guide

Step 7: Determine Student Assignments

Because students learn best by doing, it is important to follow up your presentation material with student activities in which they apply this material and get hands-on practice. Activity reinforces and expands their learning. For the sample lesson on lettering, you might require students to complete a full-page lettering activity using letters, words, sentences and numbers.

Step 8: Set Evaluation Procedures

You will need to evaluate and grade students on what they have learned. Three types of evaluation methods are commonly used in vocational-technical education classes: objective, subjective and performance evaluations.

- Objective evaluations test a student's ability to recall or recognize information. They consist of true-false, multiple-choice, matching and short-answer test items.

- Subjective evaluations test a student's understanding of theories, concepts and principles and consist of more complex short-answer questions.
- Performance evaluations test a student's ability to apply all appropriate learning in performing assigned tasks.

For the sample lesson on lettering, you might use an objective evaluation, such as a short-answer test, to determine if students adequately learned the information presented in the handout on lettering and in the lecture/discussion session. You might use a performance evaluation, such as grading the lettering activity you assigned to students, to test their lettering skills.

Make sure your test measures the learning described in your instructional objectives for the lesson. It's also important to set expected performance levels that can be converted to letter grades. In the sample lesson, you might decide to grade the objective test and the performance evaluation on a scale of 0%–100%, using the following guidelines for assigning grades: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

See Chapters 10, 11 and 12 for more detailed information on ways to evaluate students.

Before proceeding to the practical application activities and self-test, examine the completed lesson plan for this sample lesson on lettering in Appendix B.

Practical Application Activities

1. Secure a copy of a lesson plan from one of the teachers at your school and examine it closely. Ask yourself these questions about the lesson plan:
   - Is it written for an instructor or for students?
   - What components does it contain? Could it be improved by adding any others?
   - How does it compare with the lesson plan format provided in this chapter?
2. Make a list of all the things you would do to prepare for a week-long vacation in another city. Then compare the travel plan with a typical lesson plan. How are they similar? How do they differ?
3. Make a list of problems that might occur if you took a trip to a city you'd never visited without planning beforehand. Then

make a list of the problems that might occur if you tried to teach a lesson without planning it. Compare the lists.

4. Using the instructor lesson plan in Appendix B as an example, develop complete lesson plans for each of the following topics:
   - Knowledge, theories and principles in your vocational-technical specialty area.
   - Skills development in your specialty area.
   - Both knowledge and skills in your specialty area.
5. Ask your department chair or an experienced instructor to review and critique the lesson plans you completed for the above activity.

Self-Test for Chapter 6

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. Define the term *lesson plan*. Explain the difference between instructor and student lesson plans.
2. List the eight steps involved in planning a lesson.
3. What are the three components of a well-written statement of purpose?
4. What is an instructional delivery system?
5. Why is it important to list tools, equipment, supplies and instructional aids in a lesson plan?
6. Why is it important to follow up instruction with learning activities?
7. What are the three most commonly used types of evaluation in vocational-technical education classes?

CHAPTER 7

Developing Student Lesson Plans

OBJECTIVES

After completing this chapter, you will be able to:

- Define the advantages of student lesson plans.
- Identify and perform the steps in writing a student lesson plan.

While lesson plans are invaluable for teachers, they are ultimately written to help students — to make sure that students get the instruction and guidance they need to learn key skills. Using student lesson plans keeps students' needs in the forefront. This chapter will discuss how to create such plans.

Advantages of Student Lesson Plans

Student lesson plans are written as if the instructor is talking to students. These lesson plans guide the students' actions and help the instructor base his or her actions on what the students are supposed to be doing or learning. Because they guide the students' actions rather than the teacher's, student lesson plans must be more detailed and specific than instructor lesson plans.

Student lesson plans have several advantages over instructor lesson plans:

- They can be used by both students and instructors.
- They can be compiled and given to the students as a comprehensive course outline at the beginning of the course.
- If put together as a course outline, they allow the teacher to use a self-paced, competency-based delivery system, which is essential in some vocational-technical education programs.

Steps to Developing a Student Lesson Plan

There are five steps to creating a student lesson plan, and these steps generally mirror the eight steps in creating an instructor lesson plan. These steps are listed below and described in detail immediately afterward.

1. Write a statement of purpose.
2. Develop behavioral objectives.
3. List support materials.
4. List student assignments.
5. Explain evaluation procedures.

Step 1: Write a Statement of Purpose

This component is similar to its counterpart in the instructor lesson plan, except that here the statement is written from the student's perspective. It explains to students how the lesson fits into the overall course, why they are studying that particular lesson and the main topics covered. The following is a sample statement of purpose for a student lesson plan on lettering:

> This lesson is the second in a sequence of 15 lessons you must complete to satisfy the requirements of this course. The purpose of this lesson is to help you become proficient in the use of freehand lettering. Topics covered in this lesson include a definition of freehand lettering, how it is used, and why it is important; selecting the proper leads; using the lettering guide; forming individual letters; and spacing letters and words.

Step 2: Develop Behavioral Objectives

In Chapter 6, you learned to develop instructional objectives, which were stated in general terms to give you, as a teacher, an outline of what is to be taught in a given lesson. However, behavioral objectives focus on what is to be learned rather than on what is to be taught. And they state very specifically how the student's behavior will indicate mastery of the learning. Behavioral objectives must be stated in terms that allow students' competency to be objectively observed and measured.

A complete behavioral objective has three components:

- Condition
- Action
- Performance criterion

The first component describes the conditions under which the student will perform the required actions. The second component defines the actual actions required. The third component establishes the expected level of performance. Following is an example of a behavioral objective dealing with knowledge:

> Upon completion of this lesson, the student will be able to list ten different drafting fields with at least 80% accuracy.

We can break this behavioral objective down into its component parts as follows:

- Condition: upon completion of this lesson
- Action: list ten different drafting fields
- Performance criterion: at least 80% accuracy

The key to writing good behavioral objectives is to use action verbs that define observable behavior. You should avoid vague, non-action verbs such as *understand* and *appreciate* because you cannot see or easily measure understanding or appreciation.

The following examples of behavioral objectives were developed from two of the topics in the sample statement of purpose:

> After completing the lesson, you will be able to:
> - Define freehand lettering with 100% accuracy.
> - List the nine grades of lead commonly used in drafting with at least 76% accuracy.

Step 3: List Support Materials

The list of tools and supplies on a student lesson plan should include everything that students will need to complete the lesson. This list would not include materials that only the teacher will need — such as a slide projector — so you may want to make a separate list for yourself to help with lesson planning. The following is a complete list for the sample lesson plan on lettering:

- "A" size drafting paper
- Drafting tape
- Two mechanical pencils (one with a hard lead and one with a medium lead)
- Lettering guide

Step 4: List Student Assignments

The list of assignments on a student lesson plan should include everything students must do to complete the lesson. The following list could be used for the sample lesson on lettering:

1. Read carefully the handout "Engineering Lettering."
2. Participate in a lecture/discussion session on freehand lettering.
3. Observe a demonstration on using the lettering guide, forming letters and numbers and using proper spacing between letters and words.
4. Complete a full-page lettering activity on "A" size paper. See the sample lesson on the bulletin board.

Step 5: Explain Evaluation Procedures

This final section should explain exactly how students will be tested and what scoring method will be used for assigning grades. The following explanation could be used for the sample lesson plan on lettering:

> After completing this lesson, you will be tested and graded as follows:
>
> 1. You will take an objective test covering the knowledge, theories and concepts presented in the handout "Engineering Lettering," in the lecture/discussion session and in the demonstration. The test will be scored on a scale of 0–100%. You must score 76% or higher before proceeding to the performance exam.
> 2. You will be required to form letters, numbers, words and sentences, and you will be evaluated on your performance. Your performance will be scored on a scale of 0–100%. You must score 76% or higher before proceeding to the next lesson.
> 3. The following scale will be used for converting numerical scores (percentages) achieved on the tests to letter grades: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

The completed lesson plan for this unit is shown in Appendix B. Examine the completed lesson plan before proceeding to the practical activities and self-test for this chapter.

Practical Application Activity

Review the three instructor lesson plans you developed in response to Practical Application Activity 4 in Chapter 6. Convert each of these lesson plans into a student lesson plan.

Self-Test for Chapter 7

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. List three advantages of the student lesson plan over the instructor lesson plan.
2. Explain how the statement of purpose for a student lesson plan differs from that used for an instructor lesson plan.
3. List the three components of a behavioral objective.
4. List three vague verbs to avoid when writing behavioral objectives.
5. Convert the following instructional objective into a behavioral objective: Students will learn the definition of the term *orthographic projection.*

CHAPTER 8

The Computer As a Teacher's Aid

OBJECTIVES

After completing this chapter, you will:

- Be familiar with diverse ways to use a computer in teaching.
- Be familiar with some of the many kinds of computerized software applications available.
- Understand how a computer can improve classroom management.

The computer can be a tool to make teaching more effective and efficient. Once you know the basics of making a computer work for you, it can become an invaluable support in the challenging tasks of teaching.

How Computers Can Help

Just as computers have helped businesses better serve their customers, computers can help you as a teacher plan courses and respond more fully to your students' needs. But sometimes it's hard to identify which resources in the intimidating jungle of computer technology will really help. By becoming familiar with some of the basic utilities available for computers, you can get a grasp of what computer resources and processes will most help you in teaching.

Software programs, when used well, can make you more effective as a teacher and can also help reduce the stress associated with teaching. Some of the best programs are timesavers that help with record keeping and classroom management. There are also very powerful programs, particularly those connected to the Internet, for getting access to documents and information in researching a subject.

The Internet

For many people, the Internet is the on-ramp to the "Information Superhighway." When you log on to a computer system with access to the Internet, you can look at thousands of documents and sources of information and communicate with other Internet users around the world — without leaving your computer terminal. Let's look at two ways teachers can tap into the Internet: e-mail and software programs for research.

E-mail

One of the easiest ways to begin using the Internet is through the use of text-based e-mail. Through e-mail accounts, you can quickly and efficiently communicate with your colleagues, your students or other contacts across the country or the world by sending and receiving messages from your computer. And because many students are fascinated with computers and e-mail, this may be a more enticing way to get them to communicate with you than just leaving your office door open.

Through e-mail, you can also join a "listserv" — a group of people with common interests who use the Internet to "talk," to exchange information and ideas over their computer screens. A listserv could provide a forum for vocational-technical educators to bounce questions and ideas off each other. Unlike national conventions or conference calls that take much planning, listservs on the Internet let teachers from any part of the country communicate with each other instantly and spontaneously. E-mail provides a good, user-friendly way to initially get involved with the Internet.

Software Programs for Research

Other resources that may help you begin "surfing the net" are software programs that allow you easy access to the wealth of information on the World-Wide Web (a system of linked databases on the Internet). One of the most powerful and popular of these programs, called MOSAIC, helps even beginners use the Internet to its full potential.

MOSAIC allows you to browse the many sources of information contained on the World-Wide Web. Any group, association or individual hooked into the Internet — from a birdwatching club in your community to a human rights group in eastern Europe — can post documents and information on the Internet. Subsequently, any user can gain access to such documents simply by knowing the correct "address" of the information on the

system. The World-Wide Web is like a giant international encyclopedia of information about anything of interest to anyone.

With MOSAIC, a user can move easily from document to document without knowing complex computer operating system commands that were previously needed to access such data. MOSAIC also gives you access to more than just text on your computer screen. The program gives users access to still images, motion pictures and sound. This combination lets you acquire and experience multimedia information stored in the system without leaving the MOSAIC software application — such as listening to a speech by a well-known teacher educator.

Uses of MOSAIC in education are limitless. For a faculty member actively pursuing information, MOSAIC is a powerful tool for searching and accessing data. Besides the ability to search documents posted by Internet users around the world — everything from on-line journals to personal descriptions or opinions on a topic — MOSAIC gives you computer access to resources found in libraries around the world. Beyond that, many sites offer freeware or shareware programs and free images in computer format (like NASA photographs).

For example, if you are teaching a course on drafting and want to give your students a wider view of architecture throughout history than is found in drafting texts, a few hours of browsing on the World-Wide Web could yield information — from libraries, on-line architecture journals or documents posted by knowledgeable users — about periods of architecture in various countries. You might be able to print out drawings or photographs of representative architecture, excerpts from the diaries of famous architects and essays by critics — all without having to visit different libraries and museums. Such information could be shaped into a lively lesson that would give your students a broader background in architecture than they could get from standard materials.

You would most likely get access to the Internet and a software program like MOSAIC through your school. Many schools are now offering their teachers computers hooked into the Internet and software programs to accompany them. You could also buy your own software programs like MOSAIC (see "Using Computers in Planning, Instruction and Classroom Management" in Appendix D for sources), but to use such programs you would need a computer with a modem and a "graphical user interface" (an operating system in which documents appear in windows on the screen and can be manipulated with scroll bars, icons and other computer graphics functions).

Curriculum and Lesson Planning

Many software programs are available to make curriculum and lesson planning quicker and easier. Some schools have developed or installed their own curriculum planning program that they encourage teachers to use. These programs identify teaching resources — such as charts, tables and supplemental textbooks — appropriate for various standardized vocational-technical education courses. They also provide additional information on concepts, facts, skills, tools and processes related to the subject — information that might not be in most textbooks.

At the heart of these programs is a knowledge base — a list of objectives, competencies and learner outcomes for most standardized subjects — that may be matched to the curriculum framework of your state or district and to standardized exams. You can review the courses and lessons in the curriculum to see their context and planned outcomes, as well as suggested resources and preferred teaching strategies to be used with them. Curriculum planning programs also offer standard formats to use in creating lesson plans and even prepackaged lesson plans on various subjects.

Test Generators

Test generators are software programs that design and print test forms. These programs can also grade tests, freeing up a lot of teacher time. Some systems can add to each test form a consistent set of instructions individualized for each type of test (one set for true–false tests, one for multiple-choice tests, one for essay tests, etc.). Some can also provide an answer key for the instructor, which eliminates the need to reprogram the software with a new answer key for each test.

Grade Books

With various computerized grade book programs, you can keep attendance records, grade reports and other information on students in a spreadsheet format with related notes. Most grade books provide several records for classes, students and assignments. Graphing tools allow quick visual analysis of the data, while printouts of these records can help you communicate about student progress with students, parents and other educators.

In addition, you can use grade book programs to organize student seating, print mailing labels and transfer data to and from other applications. Features such as calculating and editing

tools save time and reduce paperwork. User-friendly tutorials guide new users through the steps of creating a grade book.

Monitoring Funds

Computerized spreadsheet programs can be set up to keep track of the cash flow of funds used in extracurricular activities, such as vocational student organizations (VSOs). These programs will report each day's transactions and print out a trial balance and monthly statements for each activity. No formal accounting background is required to use spreadsheet programs. Many come with built-in tutorials to help even beginning computer users work their way through the program.

Spreadsheets can also be set up to keep track of the cost of individual student projects. This requires that all projects and cost of materials be entered into the program and regularly updated. With this system in place, students can calculate the predicted cost of a project — and of using materials of various qualities — before getting too far into a costly investment.

User Groups

Various user groups are popping up on every campus, in every company and in diverse parts of the world. Becoming a member of one of these groups provides you an opportunity to discuss computer problems, share solutions and, in some cases, just lean on one another for moral support. Information sharing, conferences and training sessions are usually available to members.

Practical Application Activities

1. Contact the U.S. Department of Education and inquire about available grants for technology in education designed to help extend the "Information Superhighway" to every American classroom.
2. Attend in-service training to expand your knowledge of computers and how they can be used in teaching.
3. Interview a vocational-technical educator who is currently a member of a user group.
4. Regularly read professional journal articles that focus on software applications of practical use to vocational-technical education teachers.
5. Visit businesses that operate technical software such as AutoCAD, various computational graphic design applications or computer engineering applications.

Self-Test for Chapter 8

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. Describe at least three ways software utility programs can benefit the vocational-technical education teacher.
2. What is the World-Wide Web, and how can you easily get access to the documents on it?
3. List at least two functions teachers can perform with a gradebook program.

CHAPTER 9

Methods of Instruction

OBJECTIVES

After completing this chapter, you will be able to:

- Explain what the lecture/discussion method is and when it is an appropriate or inappropriate teaching method.
- Explain how to prepare students for a lecture/discussion session.
- Develop an opening, body and conclusion of a lecture and practice presenting the lecture.
- Explain the steps involved in preparing for, presenting and following up a demonstration.
- Describe three cooperative learning strategies and develop activities using these strategies for your class.

When you write down in your course outline what you plan to teach students, it sounds so simple and straightforward: "students will learn the basics of lettering in drafting." But if you think back to the tangle of student differences described in Chapter 1, you'll realize that figuring out how to teach a class of 30 unique individuals to become experts at lettering — or anything else — is rarely simple. A one-size-fits-all teaching method will not work.

Teaching Strategies and Choices

One of your challenges as a vocational-technical education teacher is to become skilled in several teaching methods and learn to use different methods for different material, situations and students. By varying and combining teaching methods, you will better hold your students' interest (and probably your own!) and will stand a better chance of reaching everyone, from the teenager who learns best through physical activity to the middle-aged student with performance anxiety.

The good news is that you and your students now have more learning strategies to choose from than in the past. No longer

are you expected to stick to the traditional lecture format with the occasional demonstration used in an attempt to wake up those in the back row. Many educators now recognize the importance of active learning — making students active participants rather than passive listeners waiting to receive knowledge. Demonstration, group discussion, collaborative skills projects and other teaching strategies are recognized ways to help your students become more active learners.

This chapter discusses some of the main teaching methods you can use in your classes. It also gives you guidance on which methods to use in certain situations. Of course, deciding which methods to use with different students and material is a choice best made by you, based on your knowledge of your students and class dynamics, your own strengths and weaknesses, how much freedom you're given at your school and other factors. As with other aspects of teaching, time and experience will make these choices easier — and eventually almost intuitive.

This chapter first discusses the more traditional teaching methods and then moves to some of the less traditional, more "student-centered" strategies. However, this order does not imply that the traditional strategies are always best or should be tried first. All methods described here can help students learn, and we encourage you to try all of them in your classes.

Lecture/Discussion Method

The lecture/discussion method is the oldest, most familiar, most used — and probably most abused — formal teaching strategy. Although it has drawbacks, its survival is evidence of its unique strengths as a teaching method.

A lecture is a planned, structured way of communicating information to a group of people, frequently with illustrations such as slides, charts, writing on chalkboards, etc. By itself, a lecture allows for only one-way communication, from lecturer to audience. This serious drawback is overcome by adding a discussion component, in which the teacher and students — or the students among themselves — discuss aspects of the topic being presented. During discussion, students should be doing most of the talking; the instructor's job is to keep the discussion "on-track" and moving in the right direction.

Advantages and Disadvantages

The best justification for using the lecture/discussion method is that it is an effective way to communicate information to

groups too large to allow for individual interaction between the instructor and each student. This method gives the teacher more control over the information that students are presented than methods that allow students to explore independently and form their own conclusions. If the teacher is a skilled, enthusiastic lecturer — which may require being a bit of a performer and certainly requires a passion for the subject — this method can also get students excited about a topic.

The drawbacks to this method are the flip side of its strengths. Because the teacher controls the information that is presented, students have less chance to explore and appreciate their own insights. Students who don't like speaking in large groups may not take part in the discussion. And even with a skilled instructor, many students — especially those who learn better through activity — will tune out a traditional lecture/discussion class.

The list in ***Exhibit 9-1*** describes when the lecture/discussion method is most appropriate, and when another method might be more effective.

Preparing Students for the Lecture/Discussion

Preparation is probably the most overlooked step — but the most crucial one — in using this method well. Students must be thoroughly prepared before the session. If they are not, the session will be all lecture and no discussion. You must stress to your students that their role in a lecture/discussion is not to sit and listen, but to participate. You can do several concrete things to help your students be active, contributing participants rather than passive spectators. Here are some key ways to prepare:

- Give students a written outline or overview of the lecture a day or several days before you present it.
- Require students to research all or some of the topics covered on your outline before class. They should take thorough notes while researching the topics and come prepared to share what they have learned or raise questions about things unclear to them.
- Require students to put their notes together in an annotated outline, leaving plenty of blank space for taking notes under each item during the lecture/discussion session.
- Assign specific readings that relate to the topic you will discuss and have students write down their thoughts or any questions raised by the readings.

- Instruct students to approach a lecture/discussion class as if they were entering into a debate on the topic. You may even want to divide the class into two "sides" during the discussion and ask each side to argue one view of the topic.
- Make clear that class participation in lecture/discussion sessions will count towards their semester grade.

Presenting the Lecture/Discussion

Teachers sometimes say that, in lecturing, you must "tell them what you're going to tell them, then tell them, and then tell

EXHIBIT 9-1

When To Use the Lecture/ Discussion Method

In general, it is best to use the lecture/discussion method when:

- The material to be presented deals strictly with data, theory or information (no skills development).
- Students need to be motivated before beginning a particular lesson (and you know you are an enthusiastic lecturer who can hold their interest).
- The material to be presented is not available in print.
- You want to communicate certain points but also get your students' insights.
- You need to communicate information to a large group in one session.
- You need to explain or clarify material that may be confusing.

Generally, it is best not to use the lecture/discussion method when:

- The subject matter deals with skills development or "how-to" information.
- The student group is small enough to allow for individual student-teacher interaction.
- Your main goal is to get students thinking for themselves and interacting with each other (in this case, a strategy using small groups would be better).
- Your students seem especially reluctant to participate in large-group discussions.

them what you've told them." Although this is said somewhat tongue in cheek, it is actually good advice. A well-planned, properly structured lecture contains three distinct components:

- The opening, in which you "tell them what you're going to tell them."
- The body, in which you "tell them."
- The closing, in which you "tell them what you've told them."

Generally, the opening, body and closing of a lecture should contain the elements shown in ***Exhibit 9-2.***

EXHIBIT 9-2

The General Elements of a Lecture

Opening

- Greet the class.
- State the title of the lecture (you need not formally title your lecture, but you should state its main subject).
- Explain the purpose of the lecture.
- List the objectives, so that students know exactly what they should be learning.
- Explain how the current lecture/discussion session relates to topics studied previously.
- List and define any new terms that will be used during the session.
- Present a brief overview of the content of the lecture/discussion.

Body

- Present the information in the order listed on the students' outline.
- Initiate discussion by raising specific questions, calling on students for comments and asking students if they have any questions.
- Make frequent reference to all visual aids and supportive materials.

Closing

- Remind students of the purpose and objectives of the session.
- Briefly summarize your major points and state your conclusions.
- Answer any remaining questions.
- Make follow-up assignments to reinforce the information presented in the lecture/discussion.

Discussion may be interspersed within the body of the lecture or held off until after the closing, depending on your preference. We recommend allowing discussion during the body of the lecture, while questions and concerns are fresh on the students' minds.

To help the session go well, pay attention to certain classroom logistics and your own manner as you speak and lead the discussion. Keep these points in mind:

- Before beginning, make sure that the classroom is arranged to accommodate a lecture/discussion. The seating should be arranged so that all students can see you and any visual aids you are using — and, ideally, students should be able to see each other during the discussion. Make sure all students can hear you — get a microphone if necessary, especially for a large class.
- Be enthusiastic. Enthusiasm is contagious.
- Call on students by name. They will appreciate the recognition and feel more at ease.
- Spread your attention around evenly — don't just look at or call on students who always participate. Try to make all students feel that they are part of the lecture/discussion.
- Attempt to draw all students into the activity at least once during the session.
- Maintain eye contact with students throughout the session, especially when a student is speaking to you.
- Speak clearly, evenly and slowly enough to be understood, but avoid a monotone. (Perhaps practice with a tape recorder if necessary.)
- Use facial expressions, body language and movement to emphasize points.
- Never read a lecture to the students (but feel free to use an outline or note cards to keep yourself on track).
- Reinforce major points with carefully prepared visual aids. Make sure you have all necessary equipment for your visual aids — including chalk for the blackboard.
- During the discussion, do not dominate; facilitate your students' speaking. Student participation is critical to true learning. Remember, this method includes discussion.

The Demonstration Method

Demonstration is the process through which you show your students how to perform certain skilled actions. While demonstrating the action, you explain all operations in a step-by-step progression. After you have demonstrated the action, you give your students a chance to try performing all or part of the procedure — or a simulation of it.

Advantages and Disadvantages

Demonstrations allow students to see and get hands-on experience with the tasks and activities they need to master. This teaching method has many advantages:

- It is better for reaching students who learn best visually or through physical activity rather than by hearing or reading.
- It reinforces information such as terminology, safety practices, the proper use of tools and abstract concepts associated with the vocational-technical field.
- It shows the instructor whether students really understand what they've been taught.
- It stimulates students' interest and self-confidence, and it helps students develop job-related skills.

The disadvantages of the demonstration method include the following:

- It demands a high degree of skill on your part.
- Demonstrations can take a great amount of time to prepare and present and may require equipment and materials you don't have in the classroom.
- Demonstrations can be difficult with a large group.

Preparing the Demonstration

The key to giving a good demonstration is preparation. You should prepare a clear statement of the objective of the demonstration so that both you and the students are clear on what you expect them to learn. You must then carefully and thoroughly plan every detail of the demonstration. If your demonstration is well planned and executed, it will impress on students the skills and procedures you want them to learn — it won't just be a diversion that they watch while missing the main point.

Performing the following steps will help you prepare for any demonstration:

- Decide and write down exactly what the purpose of the demonstration is, what students should get out of it, what will be demonstrated and in what order, and how long the demonstration will last.
- List all tools, equipment and instructional aids you will need for the demonstration, and make sure that everything required is available and in working order. Never put yourself in a position of having to stop a demonstration unexpectedly because some piece of equipment does not work the way it should or because a necessary tool or safety mask is not on hand.
- Set up the demonstration area so that all students will be able to easily see what is going on and hear what you are saying. You may want to arrange chairs in a circle around your demonstration area so that everyone can see you well, and you may need to arrange for a microphone so that everyone can hear you. To work out these logistics, try giving a preliminary demonstration to an audience of friends or colleagues in the classroom.
- Arrange all materials to be used in the various steps of the demonstration so that they are within reach in the order in which they will be used.
- Practice the demonstration several times before giving it so you can work out any kinks and will feel confident when you actually give it.
- Always anticipate and observe all safety precautions, and wear appropriate safety equipment.

Steps in Performing the Demonstration

Just as there are specific elements needed in a lecture/discussion session, there are specific tasks to be performed in a demonstration. Use the checklist in ***Exhibit 9-3*** to make sure you don't leave out any major steps in presenting a demonstration.

Follow-Up Student Activities

Because students learn best by doing, it is crucial to assign hands-on activities after a demonstration. No matter how well a demonstration is presented, it is really just showing and won't provide real learning until the students have a chance to try performing the action themselves. Here's an effective way to follow up demonstrations:

- Select several students (or have students volunteer) and ask them to repeat the demonstration you have just given.
- Assign all students several practical application activities that require them to apply the demonstrated skills. Assignments could include building models or actual products, such as building cabinets to apply table saw skills.
- Go around and observe each student individually as she or he performs the practical application activities. Give individual attention and assistance where needed. Be sure to correct any incorrect practices immediately so that performing the action the wrong way does not become a habit.
- Conduct performance evaluations to measure how well each student has learned the skill(s) demonstrated and identify where students need additional help.

EXHIBIT 9-3

Checklist for Performing a Demonstration

1. Arrange the seating so all students can comfortably see and hear the demonstration but not be in jeopardy from unsafe conditions.
2. Orient students to the demonstration by briefly explaining its purpose and objectives. Explain why it is important to learn the skills presented; where these skills will be used in the workforce; the proper terminology, techniques and safety procedures to be used; and how the demonstration ties in with what the students already know. For example, remind students that they have learned the basic functions of the table saw, and that this demonstration will show additional uses of the saw to cut dado and rabbet operations.
3. Present the demonstration in a slow, deliberate fashion so that students can easily follow you.
4. Pause between steps to determine if students are comprehending or to see if they have any questions that should be answered before continuing. Review any steps that students do not seem to grasp.
5. Conclude the demonstration with a brief summary and a question-and-answer session.

Cooperative Learning

Cooperative learning is a structured instructional strategy in which small groups work together towards a common goal. Cooperative learning techniques build teamwork skills and give all students a chance to participate actively in learning. Research has shown that cooperative learning has positive effects on students' overall achievement and critical thinking skills, communication skills, intergroup relations and self-esteem. Cooperative approaches are particularly effective when interaction among students is a goal. It is also a good way to promote respect for cultural diversity.

Although cooperative learning allows students with varying abilities to help each other learn, there are drawbacks to group work. This strategy gives you, the teacher, less control over what students focus on and learn. Because students in groups have different levels of ability and confidence, some students may dominate the group or end up doing most of the work while others will be uncomfortable with active participation and will therefore hold back. There is also the danger that group time, if not carefully supervised, will degenerate into a social hour or time for "goofing off."

In cooperative learning activities, the class is usually divided into small groups of two to five members who interact together to discuss a topic or complete a specific task. Tasks can represent various levels of student achievement, from something as simple as labeling auto parts on a diagram to a complex project like rebuilding an engine. Students often are graded on the task as a group rather than individually.

The teacher's role is to provide the baseline knowledge and skills that students need to work on assigned tasks, to assign and give guidelines for cooperative work and to provide students guidance on working together. The teacher also needs to monitor group work, making sure that all groups are "on task" and that students are working and cooperating.

Some teachers let students choose their own groups, but most teachers assign students to groups, trying to put students with different strengths and weaknesses together so that all group members can contribute and help each other improve. Cooperative learning does not mean putting students in groups according to ability level — for example, an advanced math group and a slow math group. Rather, it means the opposite: mixing students of varying abilities so that students who learn quicker can help those who need more explanation or practice. In the ideal cooperative learning situation, students help each other. Students

who have difficulties get extra attention (which is sometimes received better from peers than from a teacher), while students who do well gain communication skills and confidence.

Let's discuss some creative cooperative learning strategies.

Brainstorming

Brainstorming — generating as many ideas as possible without censoring or judging them — fosters creativity and may help less confident students participate. While students can brainstorm on their own, brainstorming in small groups or as an entire class usually results in more learning. Usually, the shorter period of time for interaction, the smaller the group should be.

At the start of a brainstorming session, a designated leader briefly describes the problem or topic to be explored. Participants are encouraged to spend a brief period of time (5 to 10 minutes) listing all the ideas that come to their minds regarding the topic — no matter how unusual or outrageous they might seem. Each student is encouraged to offer as many ideas as possible, without regard to their practicality. No judgments are made about which ideas are best until the post-brainstorming session. Someone in the group should write down all the ideas that members come up with, or the group should use a tape recorder to capture the ideas.

After the group has brainstormed as many ideas as possible in the time provided, group members should discuss the merits, drawbacks and feasibility of each idea. Then they should choose the best ideas from all those generated.

Brainstorming is a good method to get students relaxed, interested and thinking creatively when a topic is first introduced to them. It should be regarded as an initiating process and must be followed up with some other activity, such as research, a lecture/discussion session or a project that involves realistic planning.

Buzz Groups

This activity is best suited for a small number of students who are fairly self-directed. With the class broken into groups, you — or someone you designate — should give the groups a relevant topic to discuss. Each group should choose a leader who is responsible for directing the discussion and reporting the group's ideas back to the class as a whole. Have the groups discuss the topic on their own for 10 to 15 minutes, with the goal of

reaching a consensus. While the groups work, you should sit in on each one to make sure students are discussing the assigned topic and are working well together. At the end of the period, group leaders report their groups' consensus. This activity can lead to a larger group discussion on the topic in question.

Problem Solving

Another cooperative learning strategy is group problem solving, which encourages creativity and teamwork. Especially in a large class, this activity gives you a chance to observe more closely how individual students work.

Typically, these groups will work to solve a specific situation, such as designing or redesigning a product, solving a community or school issue or addressing a hypothetical worksite dilemma. You can assign a problem for each group to solve, or you can have all groups solve the same problem. You can even allow groups to choose their own dilemmas to solve.

Give your students guidelines for how to go about problem solving. Here is one common approach you can recommend:

1. Identify the problem to be solved.
2. Analyze and define the problem.
3. Identify information relevant to the problem.
4. Analyze the information.
5. Determine alternative solutions through brainstorming.
6. Discuss the alternatives and come to a consensus on one that the group thinks will work.
7. If possible, implement the chosen solution (or you could present students with hypothetical results of implementing their solution).
8. Evaluate how well the solution solved the problem.

As the groups work on this process, sit in with each one to observe how they are working together. This will give you a chance to work with all students and observe how each student participates as a team member. Feel free to offer some guidance and ideas, but be sure you remain mostly an observer rather than becoming so active that it ceases to be "their" group.

Suggestions on Choosing Methods

There are no clear-cut guidelines for choosing which teaching methods should be used with various material and certain students on specific days. You will have to experiment a bit and discover for yourself which method or combination of methods is most effective for a particular lesson. Here are some points to keep in mind when choosing a method:

- Can you use this method with confidence? (If not, you may need more experience and assurance as a teacher before plunging into a complicated demonstration or creative group project.)
- Is this method suitable to the objectives of your lesson?
- Can this method be adapted to your students' abilities, weaknesses and interests?
- Does this method give your students enough chance to think for themselves, explore and initiate action?
- Does this method let you observe student learning?

Practical Application Activities

1. Select a lesson that you currently teach or plan to teach and prepare a lecture for it. Make a comprehensive outline of the material for the opening, body and closing. Develop questions to encourage discussion during the body of the lecture.
2. Practice the lecture several times until you can present the material with only occasional brief glances at your notes. Practice the hand gestures, facial expressions, body language and eye movements you will use in presenting the lecture and directing the discussion.
3. Present the lecture/discussion to your class.
4. Develop a checklist of steps for preparing to give a demonstration in your classroom.
5. Select a skill area from a lesson that you teach or plan to teach and plan a demonstration for it. Develop several appropriate activities that will help students apply those skills.
6. Develop several hypothetical situations to use for a problem-solving activity in your class. Decide how you would divide your class into groups so that they could best work on this activity cooperatively.

Self-Test for Chapter 9

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. What is the lecture/discussion method of teaching?
2. List two situations in which the lecture/discussion method would be an appropriate teaching method, and two situations in which it would not be appropriate.
3. List seven elements of a lecture's opening section, three elements of its body and four elements of its closing section.
4. List the six steps to preparing a demonstration.
5. List four key steps to following up a demonstration.
6. List several advantages and disadvantages of cooperative learning strategies.

CHAPTER 10

Assessment and Testing

OBJECTIVES

After completing this chapter, you will be able to:

- Define the terms *evaluation* and *testing* and explain the differences between them.
- Explain four purposes of tests.
- Explain six characteristics of a good test.
- Explain the basic steps in test construction.
- Explain the proper use of recall, multiple-choice, true-false and matching test items.

You've gotten to know your students, identified your learning objectives, developed your course and planned and taught your first lessons. Most students have responded positively to the material and seem to understand it. You're enthusiastic and ready to plunge into the next instructional unit, but you have a nagging feeling you've forgotten something important. You have: you've forgotten to measure how much your students have really learned.

Assessing student achievement is a complicated and time-consuming task. Because testing can seem difficult and dull, it is often the most neglected feature of good teaching. Yet seeing which skills students have actually learned and which ones they still need to develop is an integral part of the teaching process. Many educators believe that thoughtful, effective testing improves the quality of student learning. At a more basic level, sheer fairness to students demands that we use the best testing methods we can, because decisions that drastically affect our students' lives are made on the basis of test scores.

Testing doesn't have to be viewed as one of your most unpleasant tasks as a vocational-technical education teacher. With a shift in attitude, you can view it as an important, meaningful activity in teaching. If you approach the testing process as a

chance to exercise your creativity and improve the learning process for your students, you will be doing your students — and yourself — an immense favor.

This chapter will give you a further understanding of the concepts of testing and evaluation, as well as guidance on developing good tests.

Defining Testing and Evaluation

As described in Chapter 3, evaluation is an important component in the four-step approach to teaching (preparation, presentation, application and evaluation). In teaching, evaluation is the process that measures student progress toward accomplishing specified learning objectives. Testing is the most frequently used, most popular method for conducting evaluations, but it is not the only method. *Evaluation* is the broad term describing the overall process of measuring progress, and *testing* is the term describing how teachers usually go about collecting the data used to evaluate students. A complete teacher-conducted evaluation of learning usually includes three components: administering tests, scoring tests and assigning grades.

The Purposes of Good Tests

Tests serve five basic purposes:

1. They provide a basis for assigning grades.
2. They provide a way to chart students' progress.
3. They help teachers improve their instruction.
4. They motivate students, who know they will be tested and graded on their knowledge and performance.
5. They help students see the skills and knowledge they have mastered and the ones they still need to develop.

To test your students accurately and well, you must clearly have in mind what is being tested and how the results of the test will be used. The test that best reflects what you have tried to teach your class is probably a test you develop yourself, but you also have the option of using a standardized test, such as one included in your textbook. Whether you are creating your own test or using a pre-made test, you must carefully examine the questions to make sure that they are worded well and clearly and that they reflect what you have actually taught in your lessons. A test prepared in a haphazard manner (by you or by someone with years of assessment experience) will not tell anyone how much the students have learned.

The Components of a Good Test

In general, a good test has six characteristics, which are listed below and described in detail immediately afterward:

1. Validity
2. Reliability
3. Objectivity
4. Discrimination
5. Comprehensiveness
6. "Score-ability"

Validity

A valid test measures what it was designed to measure. Most testing experts consider validity the most important characteristic of a good test. It's important not to set up the test in such a way that you end up measuring test-taking skills rather than the basic skills and knowledge you want to measure. For example, suppose you want to test students on whether they have learned specific vocabulary terms, so you give them a long list of words to define in only 30 minutes. However, rather than simply testing the students' knowledge of vocabulary, you are also testing how fast they can write definitions. A student who writes slowly might not complete the test even though he or she might know all the definitions. A better test might give students more time or fewer words.

Reliability

A reliable test consistently provides accurate results. Given under similar conditions to similar groups of students, a reliable test will consistently yield similar results — about the same number of students will do well, average or poorly on the test. If a test is unreliable, it cannot be valid.

Objectivity

An objective test is fair to all students. It has the same level of difficulty for people of any specific sex, age, ethnic background or any other characteristic. Answers on the test should be easily viewed as correct or incorrect and not subject to varying interpretation. A good test is also objectively administered and scored, with precise directions and scoring keys not subject to the teacher's personal interpretation.

Discrimination

A test with effective discrimination accurately separates students into groups according to their knowledge of the subject matter. With few exceptions, students who have a firm grasp of the subject matter should receive high scores, students with a moderate grasp should receive medium-range scores, and students with a poor grasp should receive low scores. As obvious as this sounds, many tests do not properly discriminate among students who know and don't know the material, and that indicates the tests are not valid.

Comprehensiveness

A comprehensive test is thorough enough to adequately measure a student's grasp of the subject matter. For example, if a test covering ten learning objectives contains only one test item per objective, it is not comprehensive enough to truly measure whether the student knows each objective. A student confused by the wording of one particular item will have no other chance to show that he or she has mastered the learning objective in question. For a test to be comprehensive, several test items are needed for each objective.

"Score-ability"

A test with "score-ability" is easy to score. Score-ability is an important characteristic because immediate feedback is critical in evaluation. Students should always receive test results before they begin to learn new material. Easy scoring also helps you as a teacher use your grading time effectively and save more time for working with your students.

Developing Tests of Cognitive Skills

Most traditional written tests evaluate students' knowledge of facts, terminology, principles and theories — what educational theorists call *cognitive knowledge*. Although written tests are only one of several methods you can — and should — use to evaluate students, they are still the major method used by most vocational-technical education teachers. Since you will use such tests often in your classes, and since you probably will want to make up your own tests rather than rely on pre-made tests, let's review the steps in developing a good test of cognitive skills.

Steps in Test Construction

Like course planning, test construction is a systematic process involving several basic steps. It's important to go through these steps in the order outlined here, making sure not to skip any.

1. Reexamine your learning objectives. By now, you will have divided your courses into units and lessons, with a set of learning objectives for each lesson. In testing, you want to measure student progress toward accomplishing these learning objectives. Therefore, the first step in preparing a test is to reexamine the learning objectives of your lesson. The test should cover these objectives.
2. Construct several test items for each objective. It's important to develop several test items for each learning objective to ensure that the completed test will be comprehensive. You should also use different types of questions (short-answer, true-false, etc.) to measure each objective.
3. Compile a draft of the completed test. Group together all of the various types of items (for example, all true-false items, all recall items, etc.). If possible, keep similar or related information together. Place the various groups of test items in an ordered sequence. Start with easier questions and move on to more difficult ones.
4. Write separate instructions for each group of test items. Clear, concise instructions that include a sample response are an important part of any test. Do not assume that students automatically know how to respond to test questions. For example, the following sample instructions are for a group of true-false questions:

   > Directions: Each of the statements below is either true or false. Indicate which by writing the word TRUE or FALSE in the blank preceding each statement.

5. Ask a colleague to examine the completed test. Getting a second opinion is always a good idea. Another teacher familiar with the subject matter can usually identify flaws or gaps that you might have overlooked in making the test.
6. Make any necessary revisions. You may want to show your revised copy to a colleague again to make sure your changes have solved the problems pointed out before. Once you are satisfied with your revised test, prepare the final copy and reproduce it for the students.
7. Make a test key. The final step — and one that must not be overlooked — is to make a copy of the test with the correct

answers written in. This, of course, is your copy and will allow you to score the test quickly and easily.

Here are some key points you should keep in mind in constructing and administering any test:

- Write questions concerning information that is really important for the students to know and understand. There is no point in "filler" or frivolous questions that test trivia that students don't really need to know.
- Make sure all items are clear and understandable. This will help keep students from wasting time or getting questions wrong because they have trouble understanding the wording or intent of the question.
- Include both easy and difficult questions so that few students get a perfect score and few fail to answer any questions correctly.
- Try to keep related material together. Moving back and forth between topics can confuse students.
- Prepare and duplicate the test in a clear, professional manner (typed on quality paper, reproduced with dark ink) so that students view it as a serious test and have no trouble with logistics such as reading blurry type.
- Make sure you allow enough time for the average student to complete the test without rushing.
- Give students adequate time to prepare for the test, usually at least a week.
- Consider the logistics of the room where students are taking the test. Make sure the room is comfortable and there is enough space between students so that they can concentrate and are not likely to look at each other's tests.
- Be aware of the potential for cheating, and do all you can to prevent it — including monitoring the students as they take the test and using different tests each time you teach a lesson or course.

Types of Test Items

There are several types of test items, which are listed below and then discussed in detail immediately afterward. A single test can include several or even all of these types.

- Recall
- True-false

- Multiple-choice
- Matching

Recall

Recall items are sometimes referred to as "fill-in-the-blank" or "short-answer" questions. They are called "recall" because the questions are posed in such a way that students must totally recall the answers from memory. (They differ from "recognition" questions, in which students must only recognize the correct answer from among a group of possible responses.) Recall questions are considered more difficult than recognition questions, such as true-false or multiple choice.

Recall items are particularly appropriate when you want to test students on "who, what, when and where" — i.e., types of information such as terminology or equations. Recall tests may more accurately reflect students' knowledge (rather than their test-taking skills) because there is less possibility of guessing the right answer or figuring out the pattern of the test than there is with recognition test items. Two disadvantages of recall items are that they measure memory rather than judgment (whereas multiple-choice items can be structured to measure

EXHIBIT 10-1

Sample Recall Test Items

Directions: Complete the following statements by filling in the blanks with the correct answer(s) or by providing a brief definition or explanation as requested.

1. The six grades of lead most frequently used in drafting are:

   a. _____ d. _____

   b. _____ e. _____

   c. _____ f. _____

2. _____ lead is considered best for lettering.
3. There are three components in a computer-aided drafting system: Hardware, software and _____.
4. Define the term "orthographic projection."
5. Explain the difference between isometric and oblique projection in as few words as possible.

judgment) and that it can be hard to design items that call for only one correct response.

Exhibit 10-1 shows sample recall test items.

True-False

True-false questions are probably the most used — and most abused — type of test item. A true-false question consists of a statement that is either true or false. Students read the statement and indicate whether it is true or false.

True-false test items offer a number of advantages. They are easy for you to create and score and easy for students to take. They allow you to cover a wide range of material on a test, and they are particularly effective when dealing with situations that have only two alternatives.

However, there are also problems with such questions. The most obvious weakness of the true-false item is that there are only two possible responses. Consequently, a person who has no knowledge of the material still has a 50% chance of indicating the correct answer merely by guessing, but guessing skews the test results and thus decreases the validity and reliability of the test. In addition, it can be difficult to construct true-false items that are completely true or completely false. It is also hard to avoid wording items ambiguously. But with careful construction, the true-false item can still be an effective test question, giving you more options in constructing your test. Here are some tips for constructing true-false test questions:

- Make approximately half of the items true and half false, but make sure there is no pattern to the answers (such as every other answer being true).
- Make all items approximately the same length.
- Don't try to "trick" students with ambiguous wording.

You can select from several simple formats to have students indicate whether an item is true or false. You can have the words "TRUE" and "FALSE" or just the letters "T" and "F" printed next to each item (either before, after, above or below the item, or in a column to the left or right), and then have the students underline or circle their selections. Or for added clarity, you might even have them underline the "true" indicators and circle the "false" indicators. Another format is to include a blank line with each item and have the students write in their selections — but drawbacks to this format are that you might have difficulty differentiating between a student's "T" and "F," and that having the

students write out "true" or "false" is more time consuming and can subtract from their time to read and contemplate the test items, thereby affecting the test's validity.

Modified true-false questions help to correct the inherent weakness of traditional true-false questions. These questions require students not only to mark items that are true, but to modify the items that are false by indicating the information that makes the item false and, if appropriate, inserting information that would make it true. Another variation is to require students to justify in writing why they marked the question true or false.

Exhibit 10-2 shows sample modified true-false test items.

EXHIBIT 10-2

Sample Modified True-False Test Items

Directions: Some of the following statements are true and some are false. If the statement is TRUE, underline the word "TRUE" above the statement and do no more. If the statement is FALSE, circle the word "FALSE" above the statement and do two additional tasks: (1) In blank "A" insert the word that makes the item false. (2) In blank "B" insert the word that would make the item true.

1. **TRUE FALSE**
   The architect's scale is used for making measurements in feet, inches, and fractions.

   A. _____

   B. _____

2. **TRUE FALSE**
   The metric scale is used for measuring feet in decimal form.

   A. _____

   B. _____

3. **TRUE FALSE**
   Circuit board drawings frequently are printed at a scale of 2:1.

   A. _____

   B. _____

Multiple-Choice

A multiple-choice item consists of a question followed by a list of possible answers. Students read the question and then select an answer from among those listed.

Multiple-choice items are particularly appropriate for questions involving definitions, principles, purposes and cause-and-effect relationships. Some advantages they offer over other types of questions are that they are easy to take and to score, their scoring is totally objective, and they help reduce wild guesses. They can be varied to test many different kinds of material.

Such questions can also be designed to measure students' judgment as well as their memories. There are several ways to modify multiple-choice questions so that students are required to make informed judgments about the material rather than just recognizing (or guessing) the right answer. Students can be required to:

- Choose the two best responses from a series of possible answers.
- Indicate the worst response or least desirable solution from the choices.
- Indicate both the best and worst responses.

A disadvantage of multiple-choice questions is that they may measure students' reading ability (their ability to quickly read through and interpret the various choices) as much as their knowledge of the subject being tested. Also, multiple-choice tests can lend themselves to testing specific but irrelevant trivia about a subject.

When constructing multiple-choice test items, you need to make sure that:

- Incorrect answers included in the list of possibilities for each item are not too obviously incorrect.
- Only one correct response is included in the list.

Exhibit 10-3 shows sample multiple-choice test items.

Matching

A variation of a multiple-choice test is a matching test, which require students to match one list of "question" items with another list of "answer" items. Like recall items, matching questions are particularly effective for testing information on "who, what, when and where."

EXHIBIT 10-3

Sample Multiple-Choice Test Items

Directions: Each of the questions below is followed by several possible correct answers. Indicate the best correct answer for the question by circling the letter next to that answer.

1. What is the long side of a right triangle called?
   a. Adjacent side
   b. Opposite side
   c. Hypotenuse side
   d. Tangent side

2. Which of the following is NOT a system drafting technique?
   a. Ink drafting
   b. Drafting on polyester
   c. Pencil drafting on vellum
   d. Composite drafting

3. Drawing is to manual drafting what _____ is to computer-aided drafting.
   a. Key stroking
   b. Manipulation
   c. Plotting
   d. Hard copying

4. You find a man unconscious on the floor of a kitchen and smell gas. You should:
   a. Call a doctor.
   b. Rub the man's arms and legs.
   c. Get him into fresh air and perform artificial respiration.
   d. Drive him to the hospital.
   e. Shake him vigorously until he wakes up.

Some advantages of matching items are that they are easy to construct, take and score, and scoring is totally objective. They also allow you to obtain a large number of student responses on one test. Some of their disadvantages are that they are not designed to measure understanding and can emphasize mere memorization of facts and figures. It can also be difficult to construct them without building in clues that reveal the answers.

Here are some tips for constructing matching items:

- Generally, have at least five but not more than 12 possible responses in each matching exercise. If there are less than five responses, you might want to consider another testing

method. Conversely, having more than 12 responses can confuse the students and lead to wasted time in reviewing the choices, thereby affecting the validity of the test. An exercise with more than 12 responses would probably be better if divided into shorter exercises.

- Make sure the answer list has more possible responses than the question list requires.
- Make sure you don't put any obviously incorrect responses in the answer list.
- Place the question list above the answer list, or place the question list on the left side of the page and the answer list on the right side.

Exhibit 10-4 shows sample matching test items.

EXHIBIT 10-4

Sample Matching Test Items

(Format 1)

Directions: Listed below are six possible items that can complete the following four statements. In the blank in each statement, write the letter of the item that best completes the statement.

a. Digitizer	d. Plotter
b. CRT workstation	e. Printer
c. Processor	f. Hard copy unit

1. _____ is the component in a computer-aided drafting configuration that resembles a cross between a television and a typewriter.
2. _____ is the component in a computer-aided drafting configuration that actually constructs the drawings.
3. _____ is the component in a computer-aided drafting hardware configuration that converts graphic data into digital data.
4. _____ is the component in a computer-aided drafting configuration that outputs alphanumeric data.

(Format 2)

Directions: Listed in the left column below are six types of measurements. In the right column are four numerical measurements. In the blank before each of the four numerical measurements, write the letter of the type of measurement that matches it.

a. millimetre	1._____ .001 metre
b. centimetre	2._____ 10 metres
c. decimetre	3._____ 1000 metres
d. decametre	4._____ .01 metre
e. hectometre	
f. kilometre	

Practical Application Activities

1. Find a vocational-technical education instructor who has a good testing program. Discuss with this instructor his or her views on testing and evaluation, the purpose of tests and specific evaluation strategies.
2. Collect several tests from teachers in your occupational area. Examine each test according to the six characteristics of a good test. How do they measure up? Take the tests yourself and ask the instructors to score them. What does your performance indicate about the validity of the tests?
3. Obtain a lesson plan for a lesson in your occupational area. Examine the learning objectives closely. Develop a test to measure student knowledge of any principles, concepts, theories and terminology covered in the lesson. Develop at least three questions for each objective and make sure to include recall, multiple-choice, true-false and matching items.
4. Ask a colleague or advanced student to examine and critique the test you developed for the activity above. Make revisions for clarification or simplification.
5. Construct a key for the test you developed.

Self-Test for Chapter 10

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. Define the terms *evaluation* and *testing*.
2. List five purposes of tests.
3. List the six characteristics of a good test.
4. List in order the seven basic steps in test construction.
5. How do "recall" questions differ from "recognition" questions?
6. What is the most obvious weakness of true-false test items? What is one strategy for overcoming this weakness?
7. List at least three advantages of multiple-choice test items.
8. List the four types of information effectively measured by matching test items.

CHAPTER 11

Other Methods of Assessment

OBJECTIVES

After completing this chapter, you will be able to:

- Explain how skills development can be measured through regular observation of students' performance.
- Explain how skills development can be measured by evaluating assigned projects.
- Develop skills tests for specific learning objectives.

Measuring cognitive skills through traditional written tests is the most well-known method of measuring students' learning — but it is far from the only one. Particularly in vocational-technical education, you will need to use other methods — such as observation, skills tests and portfolios — to measure whether students have fully developed the skills and practical abilities you have taught in the classroom.

In a vocational-technical field, unlike many other disciplines, students cannot succeed simply by being able to take tests and write papers well. In our field, students must not only retain information and express it on written tests, but they must also prove that they can ***do*** — that they can perform skilled tasks. This makes assessing your students more complicated, but also more interesting.

Evaluating Skills Development

As a vocational-technical education teacher, you can evaluate your students' skills development through observation, skills projects and tests and portfolios.

Evaluation by Observation

In a literature class, it would be impossible for a teacher to walk around the room, watch students reading and "see" if they understand the symbolism in a particular short story. In this situation, observation would be a poor evaluation method, because understanding abstract concepts is not something that can be seen. However, as a vocational-technical education teacher, your observation of your students' manipulative skills will be one of your most powerful evaluation tools.

Regular observation of students' skills development has several advantages as an evaluation technique:

- It provides a continuous measure of progress that allows for frequent and immediate feedback.
- It allows you to conduct evaluations during class without taking time away from in-class learning activities.
- It lets you correct improper procedures in skills performance before students develop permanent bad habits.

When evaluating your students by observing their performance, you need to make sure your evaluation is fair and objective, not based on your subjective opinion of a student. Here are some important tips to follow:

- Develop a list of specific key behaviors and results you expect to observe.
- Make sure your expectations are directly related to your learning objectives.
- Keep regular written records of your observations.
- Use a quantitative method for recording observations, such as rating each key behavior you observe on a scale of 1–5, rather than forming a subjective impression of students' performance. For example, a drafting instructor might use the following sample criteria in making regular observations and rating the results:

Observation and Rating	
1. Constructs lines of proper width	1 2 3 4 5
2. Constructs lines of proper darkness	1 2 3 4 5
3. Properly forms letters	1 2 3 4 5
4. Properly spaces words	1 2 3 4 5

Evaluating Skills Projects

Another effective way to evaluate what students have learned is through assigned skills projects. Once students' skills have

developed to a certain point, you can assign them projects in which they must apply some or all of the skills you have been teaching in class. For example, an automotive student at a certain level can be assigned the project of rebuilding a carburetor, or a drafting student at a certain level can be assigned the project of constructing a difficult orthographic projection.

Students can be assigned to work on projects in small groups or individually. (Individual projects give you a clearer idea of each student's actual abilities.) You can observe students as they work on the project, and then examine the completed project to judge the students' skill levels. In completing a project, students will also develop their non-occupation-specific skills such as organizing and prioritizing tasks, making decisions and meeting deadlines — and you can also evaluate these skills.

Like evaluation by observation, evaluation of completed skills projects must be based on clear criteria to be objective. You should develop a list of specific criteria and rate student performance in terms of each criterion. For example, the drafting teacher evaluating an orthographic projection project might use the checklist shown in ***Exhibit 11-1.***

EXHIBIT 11-1

Sample Checklist for Orthographic Projection Skills Project

Criteria	Possible Points	Points Earned
1. Correct solution	25	____
2. Properly dimensioned	25	____
3. Linework	10	____
4. Lettering	10	____
5. Arrowheads	10	____
6. Neatness	10	____
7. Reproductivity	10	____
TOTAL	100	____

Comments: _____

_____

In some fields like business or marketing, a skills project might involve writing a report, such as an analysis of a community's economic markets. Generally, vocational-technical education teachers do not assign lengthy papers to test students' research and writing skills, as teachers in English and other disciplines do. However, if students will need researching and writing skills in their field, writing assignments can be treated as skills projects. As with other skills projects, you should develop clear criteria for evaluating written reports.

Skills Tests

A skills test is another good way to measure students' skills development. With a skills test, you measure a student's ability to perform selected manipulative tasks by watching the student performing the tasks in a formal testing situation. Such tests can be used to measure quality of work, speed of performance and adherence to proper procedures.

Skills tests are particularly good for measuring the following:

- A student's performance under job-like conditions.
- The application of knowledge presented in a specific lesson.
- Actual skills development (not just cognitive understanding) in a given area.

Skills test are not without problems. Not only are they time consuming, but they require you to replicate job-site conditions, pay close attention and plan other activities for students waiting to take the skills test. In designing and conducting a skills test, you can overcome these drawbacks and improve the effectiveness of the test by following these steps:

1. Analyze the skills to be performed in detail. Make a list of major operations and procedures that must be followed in completing each skill activity.
2. List the tools required to perform each operation.
3. Determine the time frame for completing the test.
4. List in order the operations to be done and the key procedures and tools needed for each operation. (See the following sample plan.)
5. Ask a fellow instructor to examine all aspects of your plan, giving feedback on these questions:
   - Are all operations included?
   - Are all procedures listed in the proper sequence?
   - Are the instructions clear?

- Is the time frame realistic?

6. Make any necessary revisions based on this feedback.
7. Transform the plan into a skills test and develop a checklist to use in evaluating performance on the test.

Exhibits 11-2, 11-3 and 11-4 show examples of a plan, a skills test and a checklist developed by a drafting instructor for a lesson on laying out a three-view drawing. The plan lists the operations, procedures and tools needed to lay out a three-view drawing; the skills test was developed from the plan; and the checklist is to be used by the instructor to grade the skills test.

Portfolios

One assessment strategy especially popular today is the use of portfolios. A collection of the student's work over time, a portfolio provides evidence of the student's knowledge and skills.

EXHIBIT 11-2

Sample Plan for Laying Out a Three-View Drawing

Operations	Procedures	Tools
1. Tape paper to drafting board.	a. Align paper with top edge of parallel bar b. Tape corners of paper on top c. Tape corners of paper on bottom	i. Drafting paper ii. Drafting tape
2. Compute the amount of drawing space available.	a. Measure length of paper b. Measure width of paper	i. Scale ii. Pencil
3. Compute drawing space required in length direction.	a. Determine length of front view b. Determine width of right-side view c. Take sum of a + b	i. Scale ii. Pencil iii. Eraser
4. Compute drawing space required in width direction.	a. Determine height of front view b. Determine width of top view c. Take sum of a + b	i. Scale ii. Pencil iii. Eraser
5. Layout top, front and right-side view "boxes."	a. Layout front view box b. Layout top view box c. Layout right-side view box	i. Scale ii. Pencil iii. Eraser

EXHIBIT 11-3

Sample Skills Test for Laying Out a Three-View Drawing

Directions: This test is designed to measure your skill in laying out a three-view drawing. You will need the following materials: 1 sheet of "B" size drafting paper, 1 roll of drafting tape, 1 scale, 1 pencil and 1 eraser. Place these tools on your drafting board and proceed as follows:

1. Fasten the drafting paper to your drafting board.
2. Layout the three-view drawing provided by the instructor. You will be allowed 5 minutes to complete this activity.

EXHIBIT 11-4

Sample Skills Test Evaluation Checklist

Student Name: _____

Start Time: _____ End Time: _____ Minutes Used: _____

Operation and Procedures	Possible Points	Points Earned
1. Tape paper to drafting board.		
a. Align paper with top edge of parallel bar	10	____
b. Tape corners of paper on top	10	____
c. Tape corners of paper on bottom	10	____
2. Compute the amount of drawing space available.		
a. Measure length of paper	10	____
b. Measure width of paper	10	____
3. Compute drawing space required in length direction.		
a. Determine length of front view	10	____
b. Determine width of right-side view	10	____
c. Take sum of a + b	10	____
4. Compute drawing space required in width direction.		
a. Determine height of front view	10	____
b. Determine width of top view	10	____
c. Take sum of a + b	10	____
5. Layout top, front and right-side view "boxes."		
a. Layout front view box	10	____
b. Layout top view box	10	____
c. Layout right-side view box	10	____

Portfolios reflect the current emphasis in education that all students must provide evidence of mastering certain basic or advanced skills while in school. They also reflect the current focus in "school-to-careers" systems of increasing students' viability for employment. By showing definite examples of the student's accomplishments in school projects (rather than just the student's grade point average or test scores), a portfolio for a vocational-technical education student serves much the same purpose as a portfolio for a commercial artist or architect.

As a showcase of a student's work and skills, a portfolio can serve as a basis for a student's grade, for attracting potential employers or for matriculating into higher education programs. A portfolio will therefore contain examples of a student's work performed both inside and outside your class, and evaluations of the student directed to audiences other than you. A complete portfolio usually includes the following:

- A letter of introduction written by the student describing who he or she is, why he or she is interested in the chosen career and other brief points of personal interest.
- Evidence of research into the career field to show that the student has a good grasp of what the overall field entails, what tasks and skills various jobs in the field actually involve, what education and training are required and how participants can progress in the field.
- Letters of recommendation by teachers, employers and other individuals knowledgeable about the student's skills, knowledge, ethics and personal attributes.
- Work-related samples, including writings, drawings, products from skills projects or photographs of completed skills projects, audio or videotapes of student projects or other physical evidence showing the student's accomplishments in class and lab work or co-op and internship activities.
- Evidence of participation in student, civic or professional activities such as vocational student organizations (VSOs) and other local or national organizations. Participation in any conferences, conventions and seminars as well as any awards or leadership positions should also be listed.

To use a portfolio in grading, you should first decide which products in the portfolio are appropriate for you to grade — probably only those products accomplished as part of your course, or that reflect skills or learning objectives taught in your course. You may want to ask your students to develop a special portfolio for your class containing evidence of all the skills projects and major assignments or tests they have done in the

course. As with other kinds of evaluation, you should develop some kind of objective criteria for grading the appropriate products in the portfolio.

A sample portfolio evaluation form is shown in ***Exhibit 11-5.***

EXHIBIT 11-5

Sample Portfolio Evaluation Form

Demonstrated Competency	Level 1 Basic	Level 2 Proficient	Level 3 Advanced
Neatness	Messy, inaccurate	Clean — easy to read or handle	Accurate — pleasing to the eye
Finished Product	Gaps in skill development or knowledge	Good knowledge base with a variety of work skills	Strong understanding of career concepts, relationships of knowledge to hands-on activities
Comprehensiveness	Minimal number of projects or activities presented	Good assortment of samples indicating mastery of basic skills, knowledge and concepts	Excellent understanding indicated by a wide range of materials of top-quality work
Planning/ Organization	Piece-by-piece presentation lacking definite design or pattern of layout	Indicates evidence of planning and career development	High-level mastery of skills and knowledge; excellent understanding of career requirements; realistic in career goals
Self-Assessment	Incomplete or inaccurate evaluation of own work; does not utilize several sources of assessment	Accurate and realistic assessment of work; tends to use more than one measure	Clearly indicates understanding and insight in self-assessment; highlights own personal qualities that emphasize ability to be successful
Originality	Work is not original, is disorganized, lacks creativity and self-expression	Projects/activities are original, accurate, neat and presentable; contains several unique samples of work	Clear communication of ideas; work is accurate and thorough, almost free of errors and easily understandable

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Practical Application Activities

1. Develop an observation checklist to use in evaluating your students as you watch them perform activities in your occupational area. Have an experienced vocational-technical education teacher review and critique your checklist.
2. Develop a criteria checklist and rating form for evaluating an assigned skills project in your occupational area. Have an experienced instructor review and critique your checklist and discuss with you how it might be used.
3. Develop a skills test for a specific skill in your occupational area, completing all of the following steps:
   - Develop a comprehensive skills test plan. Ask a fellow instructor to examine it for you, and then make any necessary changes.
   - Develop the actual skills test.
   - Develop an evaluation checklist to score the skills test.
4. List the elements that could be included in portfolios for students in one of your classes, reflecting the skills they have learned in that class.

Self-Test for Chapter 11

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Do not proceed to the next chapter until you can correctly answer all items in the self-test.

1. List three advantages of regular observation as an evaluation technique.
2. List four things you can do to improve the effectiveness of evaluations by observation.
3. What can vocational-technical education instructors do to ensure that they objectively evaluate skills projects?
4. What does a skills test involve? What three things are skills tests particularly good at measuring?
5. What is a portfolio? What does it generally include?

CHAPTER 12

Scoring and Grading

OBJECTIVES

After completing this chapter, you will be able to:

- Demonstrate a method for scoring written tests.
- Demonstrate a method for scoring skills tests and projects.
- Demonstrate a method for converting numerical scores to letter grades.

You will feel a sense of accomplishment after developing an efficient, comprehensive written test, skills projects or skills test for your students. But you still have one more task to complete: you have to score and grade that test or project that your students worked so hard to complete. This chapter will discuss ways to facilitate your scoring chores and to convert scores to letter grades.

Scoring Written Tests

A score on a written test is a ratio of the number of correct answers provided by the student to the total number of answers on the test. Notice that the number of answers, not questions, is the important element to count when scoring a test, because one question might require several answers. Written test scores can most easily be expressed in terms of a percentage.

Use the following steps to determine numerical scores on written tests:

1. Count the total number of answers required on the test.
2. Count the number of correct responses.
3. Divide the number of correct responses into the total number of answers required.
4. Record the score as a percentage.

For example, suppose a test requires a total of 80 answers and a student correctly responds to 60. By dividing 60 into 80, you determine that the student's score is 75%.

Scoring Skills Tests and Projects

A score on a skills test or project is a ratio of actual performance to the highest possible performance. Two effective methods for scoring skills tests and projects are frequently used:

- A rating scale in which student performance on a number of tasks is rated from 1 to 5 or 1 to 10 (the higher the number, the better the performance).
- Points earned on a variety of criteria weighed against the total points possible.

In both of these methods, the total score for the test or project is a ratio of actual points earned to total points possible. Consider the following rating scale that might be used in scoring a skills test (in this example, the student's ratings are highlighted in bold):

Performance	Rating
1. Task 1	1 2 **3** 4 5
2. Task 2	1 2 3 **4** 5
3. Task 3	1 2 **3** 4 5
4. Task 4	1 2 **3** 4 5
5. Task 5	1 2 3 **4** 5

In this example, a perfect score would have been 25 (5 tasks with a possible score of 5 on each task). The actual score is 17 (3 + 4 + 3 + 3 + 4). This can be converted into a percentage by dividing 17 into 25, with a resulting score of 68%.

The sample below is a checklist evaluating a student's skills project, comparing possible points with points earned.

Criteria	Possible Points	Points Earned
1. Criterion 1	10	8
2. Criterion 2	10	9
3. Criterion 3	10	8
4. Criterion 4	10	7
5. Criterion 5	10	6
TOTAL	50	38

In this example, a perfect score would have been 50; the actual score earned is 38. This can be converted into a percentage by dividing 38 into 50, with a resulting score of 76%.

Converting Numerical Scores to Letter Grades

All the methods of scoring presented above result in a numerical score expressed as a percentage. The percentage is very much like a baseball player's batting average. However, vocational-technical education students usually want to see their performance expressed as a traditional grade rather than a numerical percentage. Therefore, before grading is complete, numerical scores must be converted into letter grades such as "A" through "F" or statements such as "satisfactory" or "unsatisfactory." This conversion is a simple task once you have set up a grade scale.

A grade scale is a list of all scores (percentages) from 0–100 grouped according to corresponding letter grades. The following grade scale is frequently used and has become the accepted grade scale in many educational institutions: 95–100 = A; 88–94 = B; 76–87 = C; 69–75 = D; 0–69 = F.

The same scale may be used for assigning "satisfactory" and "unsatisfactory" grades, with "satisfactory" correlating to C and above and "unsatisfactory" to D and below: 76–100 = satisfactory; 0–75 = unsatisfactory.

The procedures used by teachers in assigning grades are many and varied. The basic difference between numerical grades and letter grades is that numerical grades are absolute — an 85 is an 85, nothing more or less — whereas letter grades are flexible and contain a degree of subjectivity — a C+ might be equivalent to an 85, 86 or 87.

Some schools adopt standard grade scales for converting numerical scores to letter grades, whereas others leave the scale to the discretion of the individual teacher. If your school leaves the grade scale to your discretion, then either of the scales shown above should meet your needs.

Practical Application Activities

1. Using the test you developed for Practical Application Activity 3 in Chapter 10, determine the percentage and letter grade for each possible score. For example, if your test has 30 answers, determine the percentage and letter grade for scores of 30, 29, 28, etc.
2. Interview your principal or other school administrators to learn the school's grading scale policy and why it was chosen (i.e., whether the school has adopted one standard or whether the policy is left to the discretion of individual teachers).
3. Discuss with other teachers their preferences for using numerical scores or letter grades.

Self-Test for Chapter 12

Respond to all questions without referring to the text of the chapter. Once you have completed the self-test, check your answers by turning to the key in Appendix C. If you miss any questions, reread the material covering those questions. Your work on this chapter will be considered completed when you can correctly answer all items in the self-test.

1. List the four steps used to determine numerical scores for written tests.
2. Compute the following test scores (rounded to the nearest whole number):

Total Answers	Correct Answers	Score
53	47	____
150	127	____
68	62	____
100	76	____
175	171	____

3. Using the grade scale set forth in this chapter, indicate the letter grade that would be assigned to each score in the above question.
4. List two effective methods for scoring skills tests or projects.

APPENDIX A

Sample Course Outline

Statement of Purpose

Computer-Aided Drafting is the last of ten courses leading to an occupational certificate in drafting and design. The purpose of this course is to help students develop the fundamental knowledge, skills and attitudes required to be qualified for entry-level jobs as computer-aided drafting technician trainees.

Course Goals

After completing this course, students will be able to:

- Define the term "computer-aided drafting."
- List the components in a typical computer-aided drafting hardware configuration.
- Explain the basic operations of computer-aided drafting: input, processing and output.
- Demonstrate proficiency in the use of Cartesian Coordinate systems.
- Explain special characteristics of computer-aided drafting, including accuracy, repeatability, resolution, speed and storage.
- Explain the various types of hardware, software and users associated with computer-aided drafting.
- Demonstrate proficiency in performing computer-aided drafting tasks including digitizing, menu use, keyboard use, plotting, printing, editing, hard copying, lettering, linework, scaling, dimensioning, rotating, zooming, mirroring and levering.

Instructional Units

The course will be developed around the following units of instruction: operating system usage; menus and commands; dimensioning and plotting; drawing set-up tips and techniques; block creation and insertion; XY filters; model space and paper space concepts; libraries of symbols; and coordinates.

Method of Instruction

The teaching method recommended for this course is a combination of well-prepared lecture/discussions and demonstrations followed by assigned activities that apply key skills. To begin each lesson, students should be required to read pertinent literature in their textbooks and from the library. The instructor should then present a heavily illustrated lecture explaining and reinforcing the reading material. When appropriate, lectures should be followed by skills development demonstrations, and students should be assigned activities to apply the demonstrated skills.

Evaluation System

Objective written tests and proficiency examinations are the recommended evaluation methods for this course. Principles, theories, concepts

and terminology should be tested using objective written instruments at least once each week. Proficiency examinations requiring students to apply theories, concepts, principles, terminology and skills should be administered at least once every two weeks.

Grading System

Written tests are scored by forming a ratio of correct responses to possible correct responses. For example, a student who correctly answers 75 out of 100 questions would score 75/100, or 75%. Proficiency exams are scored by listing performance criteria and scoring student performance on each criterion on a scale of 1 (low) to 5 (high). The student's final score is his or her total score divided into the total possible score. For example, a student who scores 50 out of a total possible score of 75 would score 50/75, or 66.6%, which is rounded off to 67%.

The following scale will be used for converting numerical scores (percentages) to letter grades: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

Final grades will be computed according to the following percentages:

Average test scores	40%
Average of all proficiency exam scores	40%
Attendance score	10%
Student attitude, work habits, willingness to learn, attention to safety rules and persistence	10%
TOTAL SCORE	100%

Resource List

Required Textbook

- *Exploring Drafting*, by John R. Walker, Goodheart-Wilcox Publishers, 1996.

Recommended References

- Any dictionary of computer terminology

Tools and Supplies

- Ink
- Extra pens
- Drafting vellum
- Polyester film
- Bond paper for the CAD system plotters

Teaching Aids

- Overhead transparency projector and screen
- 35mm slide projector

APPENDIX B

Sample Lesson Plans

Sample Instructor Lesson Plan

Lesson Number and Title

Drafting Fundamentals: Lesson 2 — Freehand Lettering

Statement of Purpose

This lesson is the second in a sequence of 15 that make up the course. The purpose of this lesson is to help students become proficient in the use of freehand lettering. Topics covered include:

- A definition of freehand lettering, how it is used, and why it is important
- Selecting the proper leads
- Using the lettering guide
- Forming individual letters
- Spacing between letters and words

Instructional Objectives

Students will learn to:

- Define freehand lettering.
- Describe ten ways freehand lettering is used.
- Identify the various grades of lead used in drafting.
- Classify leads as soft, medium and hard.
- Select the proper leads for freehand lettering.
- Use the lettering guide effectively.
- Form all letters and numbers properly.
- Use proper spacing between letters and words.

Method of Instruction

The teacher will:

1. Distribute the handout entitled "Engineering Lettering."
2. Present a lecture/discussion session on lettering.
3. Present a demonstration on how to use the lettering guide, how to form letters and how to space between letters and words.
4. Have students complete a full-page lettering activity.

Support Materials

- Handout entitled "Engineering Lettering"
- Drafting paper and tape
- Two mechanical pencils
- Sample leads: 3H, 2H, H, F and B
- Lettering guide

Learning Activities

Students will:

1. Read the handout entitled "Engineering Lettering."
2. Participate in lecture/discussion session.
3. View lettering demonstration.
4. Complete a full-page lettering activity.

Evaluation and Grading

Students will be administered:

- An objective test developed from the handout, lecture/discussion material and demonstration outline, scored on a scale of 0%–100%.
- A performance test in which they must letter the alphabet, all numbers and several sentences, scored on a scale of 0%–100%.

Numerical scores (percentages) are converted to letter grades using the following scale: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

Sample Student Lesson Plan

Lesson Number and Title

Drafting Fundamentals: Lesson 2 — Freehand Lettering

Statement of Purpose

This lesson is the second in a sequence of 15 that you must complete to satisfy the requirements of the course. The purpose of this lesson is to help you became proficient in the use of freehand lettering. Topics covered in this lesson include:

- A definition of freehand lettering, how it is used, and why it is important
- Selecting the proper leads
- Using the lettering guide
- Forming individual letters
- Spacing between letters and words

Behavioral Objectives

After completing this lesson, you will be able to:

- State orally or in writing the definition of freehand lettering, with 100% accuracy.
- List ten ways freehand lettering is used, with 76% accuracy or better.
- List the nine grades of lead commonly used in drafting, with 76% accuracy or better.
- Classify the nine grades of lead used in drafting as being hard, medium or soft, with 76% accuracy or better.
- Select the proper leads for making guidelines, forming letters and forming numbers, with 100% accuracy.
- Demonstrate, with 100% accuracy, how to use a lettering guide for making the following guidelines: one-eighth, three-sixteenths, one-fourth and five-sixteenths.
- Demonstrate how to properly form all letters of the alphabet, with 100% accuracy.
- Demonstrate how to properly form all numbers (0–9), with 100% accuracy.
- Demonstrate how to properly space between letters, with 100% accuracy.
- Demonstrate how to properly space between words, with 100% accuracy.

Assignments

1. Receive the handout entitled "Engineering Lettering" and read it carefully.
2. Participate in a lecture/discussion session on freehand lettering.
3. Observe a demonstration on using the letter guide, forming letters and numbers and spacing between letters and words.
4. Complete a full-page lettering activity (see sample on bulletin board).

Materials Required

You will need the following materials to complete this lesson:

- "A" size drafting paper
- Drafting tape
- Two mechanical pencils (one with a hard lead and one with a medium lead)
- Lettering guide

Testing and Grading

After completing your fourth assignment for this lesson, you will be tested, and grades will be assigned as explained below:

1. You will take an objective test covering the knowledge, theories and concepts presented in the handout, lecture/discussion session and demonstration. The test will be scored on a scale of 0%–100%. You must score 76% or higher before proceeding to the performance examination.
2. You will perform a graded lettering activity, requiring you to form letters, numbers, words and sentences. The activity will be scored on a scale of 0%–100%. You must score 76% or higher before proceeding to Lesson 3.
3. Numerical scores (percentages) on both tests will be converted to letter grades using the following scale: 95–100 = A; 88–94 = B; 76–87 = C; 70–75 = D; 0–69 = F.

APPENDIX C

Answer Keys to Self-Tests

Chapter 1

1. This term refers to students that fall on either end of the continuum of ability — from students who have one or more learning disabilities to students who are considered academically gifted.
2. Because vocational-technical education teachers will need to adjust their curriculum and teaching methods to provide appropriate learning experiences for students who have learning disabilities, who learn faster than others or who have unusual learning styles.
3. Because different teaching methods and strategies work better for reaching students with different learning styles.
4. The student's age, interests in and out of school, employment and family situation, career background, etc.

Chapter 2

1. a. Assemble and organize the syllabus, texts, teacher guides and student guides for each course to be taught.

   b. Before beginning your course, carefully analyze tests published for the textbooks you are using, or try to obtain other tests from publishers or fellow teachers.

   c. Make sure you have all the proper tools, equipment and materials needed to teach the course content you have selected. If you do not have the tools to teach your chosen content, you will need to modify your course — or be proactive in obtaining needed resources by contacting your supervisors, school administrators or other sources, such as local business partners.

   d. Review laboratory setups to ensure that the activities you are planning can be accomplished within the constraints or limitations of the facilities — or take proactive measures to overcome those constraints or limitations.
2. Research on what qualities are most important in teachers has been and is continually being performed. Studies have identified many key attributes — including cooperativeness, patience, communication skills and many others. However, no one person could possess all the attributes that have been identified as good for teaching.
3. Whether the experiences you have provided in the course prepare students well for success in their vocational-technical field.

Chapter 3

1. Helping students learn.
2. Because people learn best when they understand how the material they are learning is relevant to their lives.

3. Because people tend to learn material best when it is presented in logical progression.
4. Because people learn best by moving from the known to the unknown.
5. Activities that build thinking or reasoning skills.
6. Because you are testing feelings or attitudes that are hard to observe objectively and to measure quantitatively.
7. Because success in learning stimulates additional learning.
8. a. Preparation: Instructor prepares himself/herself, the shop or classroom and the students to ensure successful teaching and learning.
   b. Presentation: Instructor presents the material as a lesson using one of a variety of methods.
   c. Application: Instructor gives the students practical application activities so they can learn by doing.
   d. Evaluation: Student and teacher determine how much learning has taken place.

Chapter 4

1. a. Curriculum: All of the planned experiences provided for students under the direction of the school.
   b. School curriculum: All the planned experiences that the school provides for students through its educational programs.
   c. Program curriculum: All the planned experiences provided students under the direction of an individual vocational-technical education program.
   d. Course: A plan for one well-defined part of a program curriculum that is designed to help students meet a set of learning goals.
   e. Course outline: A master plan, or "blueprint," for teaching a course.
2. A course outline contains:
   - A statement of purpose
   - A set of course goals
   - A list of the units making up the course
   - An explanation of how you will instruct students
   - An explanation of how you will evaluate students
   - An explanation of how you will compute grades
   - A resource list
3. What students will learn in the course.

Chapter 5

1. The overall purpose of the course and where it fits into the program curriculum.
2. Each teacher's topics will be different, but here are two examples:
   a. Topic to be covered: Arrangement of keys on a typewriter keyboard

Corresponding learning goal: Students will learn to identify specific keys on an unmarked typewriter keyboard.

b. Topic to be covered: Family budgeting

Corresponding learning goal: Students will learn to develop and maintain a monthly family budget for a specified number of people based on a specific annual income.

3. The methods an instructor will use to present instruction and facilitate learning in a course.
4. The methods a teacher will use to measure students' learning, development and progress in a course.
5. a. An explanation of how written tests are scored.
   b. An explanation of how skills projects or skills tests are scored.
   c. An explanation of how numerical scores (percentages) are converted to letter grades.
   d. A percentage breakdown for computing final grades.

Chapter 6

1. A teacher's "road map" for a particular lesson, containing a summary of all information the teacher needs to present a lesson. Instructor lesson plans are written in terms of the instructor's behavior. Student lesson plans are written in terms of the student's behavior.
2. a. Determine units and lessons.
   b. Set sequence and give each lesson a number and name.
   c. Write a statement of purpose.
   d. Develop objectives.
   e. Choose presentation method.
   f. Select support materials.
   g. Determine student assignments.
   h. Set evaluation procedures.
3. a. How the lesson fits into the overall sequence of lessons
   b. Purpose of the lesson
   c. Major topics covered
4. The methods that will be used in teaching a lesson.
5. To ensure that all necessary materials are available and in working order.
6. Because students learn best by doing. Learning activities reinforce their learning.
7. a. Objective
   b. Subjective
   c. Performance

Chapter 7

1. a. Student lesson plans can be used by both students and instructors.
   b. They can be put together and given to students as comprehensive course outlines.
   c. They allow for a self-paced, competency-based delivery system.
2. It is written from the student's perspective.
3. a. Condition
   b. Action
   c. Performance criterion
4. Examples: *know, appreciate, understand, comprehend, realize.*
5. After completing this lesson, the student will be able to state the definition of *orthographic projection* with 100% accuracy.

Chapter 8

1. a. Classroom management
   b. Record keeping (such as keeping track of grades, inventories, etc.)
   c. Research and information gathering
2. A system of linked databases on the Internet. You can get easy access through a software program like MOSAIC.
3. Keep an attendance record; keep track of students' grades and other student information on spreadsheets; construct graphs to visually analyze student data and communicate with others about it; organize student seating; print mailing labels.

Chapter 9

1. It is a planned, structured method of presenting information to groups of students and allowing them to discuss the information.
2. The lecture/discussion method is appropriate in any of the following situations:
   - When the material to be presented is strictly data, theory or information.
   - When the students need to be motivated and you are a skilled lecturer.
   - When the material to be presented does not appear in print.
   - When you want to communicate information to students but also have them interact and share their insights.
   - When it is necessary to communicate information to a large group in one session.
   - When you need to explain or clarify material that may be confusing.

   The lecture/discussion method is NOT appropriate in any of the following situations:
   - When the subject matter deals with skills development or "how-to" information.

- When the student group is small enough to allow for individual student-teacher interaction.
- When your main goal is to get students thinking for themselves and interacting in small groups.
- When your students are very reluctant to participate in large-group discussions.

3. a. Opening
   - Greet the class.
   - State the title of the lecture.
   - Explain the purpose of the lecture.
   - List the objectives of the lecture.
   - Relate current lecture to information discussed previously.
   - Define new terms.
   - Present an overview of the lecture.

   b. Body
   - Present the information.
   - Initiate discussion among students.
   - Make frequent reference to visual aids.

   c. Closing
   - Restate the purpose and objectives.
   - Briefly summarize major points and state conclusions.
   - Answer remaining questions.
   - Make follow-up assignments.

4. a. Decide on the purpose and length of the demonstration.
   b. Gather all necessary materials and make sure that they are in working order.
   c. Arrange seating so that all students will be able to see and hear.
   d. Arrange all materials to correspond with the order of presentation.
   e. Practice giving the demonstration several times.
   f. Anticipate and prepare to observe safety precautions.

5. a. Have several students repeat the demonstration.
   b. Assign several practical application activities.
   c. Observe students individually and give assistance when needed.
   d. Conduct performance evaluations.

6. a. Advantages:
   - Students can build teamwork and interaction skills.
   - All students have a chance to actively participate in learning.
   - Positive effects occur in students' achievement, critical thinking, communication skills and self-esteem.
   - Students with different abilities can help each other.

b. Disadvantages:
   - Teacher has less control over what students focus on and learn.
   - Some students may dominate the group while others don't participate.
   - Group time may degenerate into "social time."

Chapter 10

1. Evaluation is the process by which students' progress toward accomplishing specific learning objectives is measured. Testing is the method generally used for collecting data to conduct evaluations.
2. a. Provide a basis for assigning grades.
   b. Provide a way to chart students' progress.
   c. Help instructors improve their instruction.
   d. Motivate students to learn.
   e. Help students see the skills and knowledge they have mastered and the ones they still need to develop.
3. a. Validity
   b. Reliability
   c. Objectivity
   d. Discrimination
   e. Comprehensiveness
   f. "Score-ability"
4. a. Reexamine your learning objectives.
   b. Construct several test items for each objective.
   c. Compile a draft of the completed test.
   d. Write instructions for each group of test items.
   e. Ask a colleague to examine the completed test.
   f. Make any necessary revisions and prepare the final copy.
   g. Make a test key.
5. With "recall" questions, students must totally recall the answers from memory with no clues, whereas with "recognition" questions, students must only recognize the correct answer from among a group of possible responses.
6. Because there are only two possible alternatives, the guessing factor is increased. Modified true-false questions can overcome this weakness.
7. a. They are easy to take.
   b. They are easy to score.
   c. Scoring is totally objective.
   d. They reduce the guessing factor.
8. "Who, what, when and where" information.

Chapter 11

1. a. It provides a continuous measure of progress that allows for frequent and immediate feedback.
   b. It allows the instructor to conduct evaluations during class without taking time away from in-class learning activities.
   c. It allows the instructor to correct improper procedures in skills performance before students develop permanent bad habits.
2. a. Develop a list of specific behaviors and results that you expect to observe.
   b. Relate observations directly to learning objectives.
   c. Keep regular written records of observations.
   d. Use a quantitative method for recording observations.
3. Develop a list of specific criteria to be applied and a method for rating student performance in terms of each criterion.
4. A skills test involves watching a student perform a skilled task in a formal testing situation. Skills tests are particularly good at measuring:
   - A student's performance under job-like conditions
   - The application of knowledge presented in a specific lesson
   - Actual skills development in a given area
5. A collection of the student's work over time that gives evidence of that student's knowledge and skills. A portfolio usually includes:
   - A letter of introduction
   - Research the student has done into the career field
   - Letters of recommendation
   - Work-related samples
   - Evidence of student, civic and professional activities

Chapter 12

1. a. Count the total number of answers required on the test.
   b. Count the number of correct responses.
   c. Divide the number of correct responses into the total number of answers required.
   d. Record the score as a percentage.
2. a. 89
   b. 85
   c. 91
   d. 76
   e. 98

3. a. B
   b. C
   c. B
   d. C
   e. A
4. a. A rating scale in which student performance on a number of tasks is rated from 1 to 5 or 1 to 10 (the higher the number, the better the performance).
   b. Points earned on a variety of criteria weighed against the total points possible.

APPENDIX D

Supplemental Resources

Curriculum Development, Course Planning and Lesson Planning

Bartel, Carl R. *Instructional Analysis & Materials Development*. American Technical Society, Chicago, 1976.

Copa, George and Jerry Moss. *Planning and Vocational Education*. McGraw-Hill, New York, 1993.

Duenk, Lester G. *Improving Vocational Curriculum*. Goodheart-Wilcox Publishers, South Holland, IL, 1993.

Finch, Curtis and John Crunkilton. *Curriculum Development in Vocational & Technical Education*. Allyn & Bacon, Needham Heights, MA, 1993.

Frantz, Nevin R. Jr. *Individualized Instructional Systems for Vocational & Technical Education: A Series of Instructional Modules*. Vocational Instructional Systems, Athens, GA, 1974.

Fryklund, Verne C. *Occupational Analysis Techniques and Procedures*. Bruce Publishing Company, New York, 1970.

Hanak, Richard M. *Lesson Planning for Meaningful Variety in Teaching*. National Education Association, Washington, DC, 1980.

Mager, Robert F. *Preparing Instructional Objectives*. Lake Publishing, Belmont, CA, 1984.

Silvius, G. Harold and Ralph Bohn. *Planning and Organizing Instruction*. McKnight Publishing Company, Bloomington, IL, 1976.

Teaching, Classroom Management and Educational Theory

Bott, Paul A. *Teaching Your Occupation to Others*. National Publishers, Elmsford, NY, 1987.

Chernow, Fred B. and Carol Chernow. *Classroom Discipline and Control: 101 Practical Techniques*. Parker Publishing, West Nyack, NY, 1981.

Cummings, Carol. *Teaching Makes a Difference*. Snohomish Publishing Company, Snohomish, WA, 1985.

Evans, Rupert and David Terry. *Changing the Role of Vocational Teacher Education*. McKnight & McKnight Publishing, Bloomington, IL, 1971.

House, Ernest and Stephan Lapan. *Survival in the Classroom*. Griffon Press, Urbana, IL, 1978.

Investing in Our Children. Committee for Economic Development, 1985.

Lehr, Judy and Hazel Wiggins Harris. *At Risk, Low-Achieving Students in the Classroom*. National Education Association, Washington, DC, 1989.

Littrell, Joseph J. *Guide to Industrial Teaching*. Chas. A. Bennett, Peoria, IL, 1970.

Miller, W.R. *Instructors and Their Jobs*. American Technical Publishers, Homewood, IL, 1990.

Patterson, Jerry L. *Leadership for Tomorrow's Schools*. Association for Supervision and Curriculum Development, Alexandria, VA, 1993.

Silvernail, David L. *Teaching Styles As Related to Student Achievement*. National Education Association, Washington, DC, 1986.

Smith, Joan K. and L. Glenn Smith. *Education Today: The Foundations of a Profession*. St. Martin's, New York, 1994.

What Works: Research About Teaching and Learning. U.S. Department of Education, Washington, DC, 1987.

Assessment

[Editor's note: Many of the previously listed resources also contain units on assessing students.]

Mager, Robert F. *Measuring Instructional Results (or Got a Match?)*. Lake Publishing, Belmont, CA, 1984.

Micheels, William and M. Ray Karnes. *Measuring Educational Achievement*. McGraw-Hill, New York, 1950.

Using Computers in Planning, Instruction and Classroom Management

Following are just a few companies that offer computer software and other resources geared toward vocational-technical teaching:

American Association of Vocational Instructional Materials, 220 Smithonia Road, Winterville, GA 30683 (706-742-5355).

General Motors Corporation, 30501 Van Dyke Ave., Warren, MI 48090, (800-393-4831).

Instructional Materials Lab (UMC), 2316 Industrial Drive, Columbia, MO 65202 (314-882-2883).

Oklahoma CIMC/MAVCC, 1500 W. 7th, Stillwater, OK 74074 (405-743-5590).

V-Tecs, Southern Association of Colleges and Schools, 1866 Southern Lane, Decatur, GA 30033-4097 (404-679-4501, ext. 543).

Southeastern Instructional Materials, P.O. Box 70158, Tuscaloosa, AL 35407 (205-345-2725).

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